THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 58 Thursday, February 24, 1938 No. 1123

PUBLISHED WEEKLY

Subscription Terms : 17s. 6d. per annum.

Foreign and Colonial : 20s. per annum.

All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address : "Zacatecas, Rand, London."
Telephone : Temple Bar 3951 (5 lines).

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF

The Institute of British Foundrymen

The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

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Coal and Oil

The conclusions of the committee of which Viscount Falmouth has been chairman will interest not only industrial users of oil but also private consumers of petrol and all concerned with national defence. Coal is our greatest industrial asset, while virtually all the oil we use has to be imported. Processes are now available for processing coal to yield oil. Would it pay to develop our own resources for oil production? The Falmouth Committee says not. Large-scale plants would provide a useful market for the ironfounder, who is already interested in the various plants at gasworks and elsewhere for treating coal. It is stated that only 7 per cent. of motor spirit and a negligible amount of fuel oil are produced at home. But to build plants would involve heavy expenditure, and they would be as liable to air attack as tankers are to attack at sea, and the risk would be concentrated on a comparatively small number of centres. Tankers bringing oil could bring 12 times as much for the same expenditure as a hydrogenation plant would yield.

The committee point out that drilling has so far been unable to locate a home supply, and two industrial processes are available. Carbonisation processes in the gas and coke oven industries produced over fifty million gallons of motor spirit in 1936, and a further twenty millions could be got in future. Low-temperature carbonisation must be ruled out as a possible substantial source of supply. The remaining process, hydrogenation, is illustrated in the large plant at Billingham and is virtually in full operation. A number of difficulties have been experienced in treating the coal, and the petrol yield has not reached expectations. The committee recommend the continuation of the preference on spirit at a rate of 8d. per gallon for 12 years, and to include oil for use in motors. This, it is hoped, will stimulate experiment further to cheapen the production of oil. Capital aid to establish low-temperature carbonisation plants is not justified, although such plants should share in the guaranteed preference. The Fischer process has attracted a lot of attention as having some points of advantage over the Bergius hydrogenation process, and the committee say that a plant of sufficient size would be advantageous, but Government expenditure should be limited to money for special research only. The shale oil process in Scotland should be encouraged by the guaranteed preference. Generally, as there is no likelihood of a world advance in price of petroleum products, there is no immediate possibility of an oil-from-coal industry on a basis of competition with imported oils. Many of the immediate hopes for the future of the coal industry must die with this report, as also must some of those in the special areas where coal-oil processes have been established.

Esperanto and Technology

More people than we imagined appear to be interested in the application of Esperanto to technology. As a means of simple communication between two people speaking different national languages, it has much to commend it, but from either the literary or the technical aspect it seems to us to fall far short of the ideal. In the former case any literature must be, in general, confined to translations, and, with few exceptions, much of real value is lost through changing into a second language. Experts say that with the solitary exception of Tolstoi, English is but a poor vehicle for conveying a real conception of Russian literature, whilst German, on the other hand, lends itself very well. To read Dickens in French is to read a story devoid of the spirit of Dickens. On these grounds, Esperanto fails as a literary force.

For technology, it seems to be but little realised that the English language is particularly rich. Its terms have come naturally, and for the most part are not ambiguous. The sole disadvantage is the plethora of localisms—often wonderfully expressive and worthy of national adoption. German, to our mind, is fairly poor, and attempts to make technical words 100 per cent. Teutonic have resulted either in the replacement in a word of Latin or Greek origin of a "c" by a "k" or phrase words of inordinate length and complication. Ambiguity is well shown by the fact that a taxi-cab driver, a chauffeur, the driver of a car and Herr Hitler himself are all *Fuhrer*. Inherently these defects are due to the purity of the language. French, too, contains an inadequate number of technical words, and in conversation far too much resort is made to words which would translate into English as "gadget," or "thingumbob." Again, words like *armature*, *garnissage* and *chemise* have to serve between them for some dozens of really distinctive technical terms. In the case of *armature*, we recently had to give it, in the course of one article, three distinct translations. On its first appearance, it signified the belt of a ladle, the second time it referred to a core grid, and finally to the plating of a furnace. These examples by no means exhaust the possible meanings of this one word.

Yet these two languages, German and French, would be considered by most philologists to be

(*Continued on page* 174.)

Correspondence

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Contraction in Cast Iron

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I am obliged to your correspondent, "Mancunian," for his remarks published in the issue of February 17, for the value he places on my investigations into contraction in grey cast iron, and the opportunity he affords me further to explain the conclusions based on the small test castings outlined, all too briefly, and sketched as shown in Fig. 5.

That "Mancunian" may be a little puzzled can be understood, because a paragraph and a photograph of the actual test castings which explained more fully the comparisons between the two sets of tests were wrongly omitted in a general attempt to shorten a long lecture. The discourse and data on design in relationship to contraction and distortion form a part of a very long lecture which I delivered to the Scottish Branch of the Institute of British Foundrymen.

The contraction phenomena can best be understood by using the word "phenomena" in this instance to mean something definitely diagnosed as unusual as understood when consideration is taken of ordinary calculations and observations and, also, the theoretical physical characteristics of grey cast iron. Or one might use, instead, the word "anomalous" as meaning something deviating from rule as set by known and calculated standards, as for instance that "grey cast iron contracts $\frac{1}{8}$ in. per ft." Just as the word "scientific" when applied as scientific control ceases to be scientific with usage, so in time what we now term "phenomena" may become a standard set by rule and calculation.

Of course, the internal parts of the test bar mould are constricted (contracted means the same in this case) when the casting contracts. The encircled portions of the mould must inevitably be squeezed in the process to allow any contraction of the casting. But if it were possible to pour the casting without a sand mould, then, after discounting the frictional resistance of the mould, almost the same cooling behaviour would take place.

The contraction phenomena noted in several tests and referred to in Fig. 5 of my Paper revealed the following anomalies in the bars poured as a multiple casting and by comparison as single castings. The lengths of the various members composing the test casting, excluding the ends binding the multiple bar casting, were 24 in., and 1 in. in depth varying in thickness from $\frac{1}{4}$ in. to 1 in.:—

	Separately poured.	As multiple bar casting.
Thousandth parts 1 in. contraction on 1 in. bar ..	236	258
Thousandth parts 1 in. contraction on $\frac{3}{4}$ in. bar ..	248	232
Thousandth parts 1 in. contraction on $\frac{1}{2}$ in. bar ..	257	227
Thousandth parts 1 in. contraction on $\frac{1}{4}$ in. bar ..	265	224

Before fracturing the multiple bar casting the $\frac{1}{4}$-in. section was seen to be well cambered as exaggerated in the sketch, Fig. 5, and the thicker bars bent slightly in the opposite direction. After fracturing the frame at one end the bars extend and lengthen by taking up a straighter line. Actually, the thin bar on its release takes up a slightly opposite camber from that shown when confined and held by the rest of the test casting. The thicker bars retain much of the original bend after fracturing the end of the frame between each bar.

The explanation of what happens when the multiple bar casting cools is probably as follows:—The metal when at a high temperature, or semi-plastic, possesses the property of either elongation or contraction. The $\frac{1}{4}$-in. section solidifies and then exerts a tensile stress on the ends of the frame holding the bars. The ends will have become firm and responding to the contraction pull of the thin section will compress the thicker bars still in a semi-plastic condition. A similar state of contraction and stress will operate on the next thinner bar and so on until all is solid. After solidification of the various sections there is a progressive contraction at a period according to the section of the bar. As the next thicker bar cools it is opposed by a thinner bar already much cooler. The thin section must then bend or break to take up a shorter line as determined by the thicker bar on cooling.

The many tests taken on large castings tend to confirm the conclusions that the thin sections of a casting suffer in many designs a degree or form of extensional stress due to the resistance set up by the adjacent and, also, more remote thicker and more slowly-cooled sections of the casting, and the frictional resistance of the mould and cores to contraction of the early-cooled section; and that the thicker sections are subject to compressional stress whilst in a molten or semi-molten condition by the effort of the thinner sections to take up a shorter length

It will be readily understood that the heat gradients in a mould will confuse and hinder direct effects of contracting sections and location of such sections in a mould. The residual strains and stress in large castings may be revealed, years after having been cast, in the form of assumed unaccountable fractures and distortion.—Yours, etc.,

E. LONGDEN,
Foundry Manager.

Craven Bros., Limited,
Manchester.

February 18, 1938.

Esperanto

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—References have been made in your last issues to the language difficulty at international meetings, and more generally, in international relations of a technical nature; and the use of the international auxiliary language, "Esperanto," has been advocated to overcome it.

As I write, I have before me issues of the monthly Journal of the French Society of Electricians, and also of "Le Phare Médical," a French medical monthly. In both reviews a synopsis in Esperanto precedes or follows each article.

In another medical monthly issued in Prague, the "Lekarská Revue," I find the Esperanto synopsis of the main articles gathered at the end of the review. This latter arrangement is possibly preferable from the printers' point of view, but the former seems better for the readers. In any case, both point to what should be done by all technical reviews of world-wide circulation. A few days' study of Esperanto would enable persons of average instruction, and of any nationality, to read without difficulty such a synopsis of an article relating to their usual pursuits. I believe that increased circulation would result ultimately from the adoption of such a policy.—Yours, etc.,

T. J. GUERITTE.
(*Past-President, Society of Engineers (Inc.); Président d'Honneur, French Chamber of Commerce in London*).

Members Mansions,
36 and 38, Victoria Street, S.W.1.
February 18, 1938.

DARWINS, LIMITED, Sheffield, have conditionally agreed to purchase all the issued share capital of Andrews Toledo, Limited.

Random Shots

In England when a man wants a day off the traditional excuse is his grandmother's funeral. On the Continent, especially in Italy and Spain, there is a continual succession of *fiestas* to provide such holidays. Indeed, even the feast-day of the foundryman's patron Saint passes unquaffed and unsung in this country. That red-letter day falls at some time in November and would make a pretty excuse for a day off to do the Christmas shopping. However, as it is yet only February, why not adopt Shrove Tuesday, which falls next week, as a special day of rejoicing? It has special claim to attention in foundry families, to say the least of it, for does not every member of the family look forward to the annual pancake? And is not that delectable sweet most probably weighed out on an iron scale, mixed in an enamelled basin, beaten with a nickel silver fork, and finally tossed in a cast-iron pan?

* * *

In passing, however, is it not indeed a sad reflection that even the innocent pancake is capable of making one realise that "things is not what they was"? In the gay Edwardian days, when most households had many helping hands, pancakes were served quickly and merrily to the assembled family, father at the head of the table, a beaming and serene mother opposite, and half-a-dozen expectant children around. Nowadays, with one child and a modern house which almost, but not quite, runs itself, it has to be admitted that pancakes have become more of a nuisance than a pleasure. To be enjoyed they should be eaten as soon as made, a sort of knit one, make one, slip one down the throat idea, and it is disconcerting to have one's wife jumping up every few minutes to make another, as if she had inadvertently sat on a new-born casting. So the custom is dying out along with many others of those serene secure times. The foundryman's only consolation is that it will not seriously affect the sale of his wares, for man must eat, and if it is not to be pancake, it must necessarily be something else.

* * *

In recent years there has been a gradual orientation of business offices from the City to the West End. Victoria Street and the Kingsway have been given over almost entirely to offices for some considerable time, but the latest vicinity to be acquired is Grosvenor Place. Those who take up their quarters in this neighbourhood are indeed lucky, for their office windows overlook the gardens of Buckingham Palace. It will be well worth the daily climb to a top floor office, in buildings where lifts are not yet installed, because the view over the gardens, Green Park, St. James' Park and to Westminster is truly surprising and magnificent.

"MARKSMAN."

Esperanto and Technology

(*Continued from page* 173.)

exceedingly rich in technical terminology, and Esperanto by comparison would rank with Swahili and Bantu, as most of the terms would have to be invented. Here a minimum of words of a generic character are likely to be incorporated, which makes for the type of ambiguity such as we have indicated above, and which is undesirable. If, however, Esperanto can induce people, whether they be writing in English, French or any other language, to state clearly what they mean, we shall be only too happy to give it our support, for this diffuseness of expression, to our mind, is a greater bugbear than any language difficulty. The failure of foundry executives of all nations to differentiate between a casting, a mould or a pattern is sometimes amazing!

British Industries Fair

SOME CASTLE BROMWICH EXHIBITS

It should not be thought, because foundry equipment and supply exhibits have decreased to almost vanishing point, that a visit to the Castle Bromwich Section of the British Industries Fair is not worth while. The contrary is the case; a wealth of plant and material is shown which is common to all the metallurgical industries, such as welding apparatus, furnaces, refractories, pyrometers, pig-iron and portable tools. As the Fair, which opened on Monday and remains open until March 4, is so very extensive, the object of this survey is to indicate the stands which we deem to be of major interest to our readers. Most of the exhibits, except some refractories, are in Group D, the section of the exhibition furthest away from the railway station. Probably a hundred or more foundries are showing their products in the form of machine tools, stoves, baths, ironmongery, hardware, hollow-ware, and so on, but these are obviously dispersed throughout the whole exhibition. In the following description the firms showing are set out alphabetically, whilst the headings indicate the principal exhibits on each stand from the foundry point of view.

PROTECTIVE FINISHES

Atlas Preservative Company, Limited, Erith, Kent (Stand No. D632), display a number of mechanical devices which keep films of highly resistant paints in constant torsional movement in order to demonstrate their noteworthy mechanical strength. The fume and acid resisting properties of Atlas "Ruskilla" and other paints are shown by exposure samples, whilst their industrial application is shown by photographs of some of the largest foundry buildings in the country which have been treated by this firm's products.

TESTING MACHINES

On Stand No. D515 and 413 *W. & T. Avery, Limited*, Birmingham, are shown examples of the latest developments in testing machines, industrial weighing equipment, and counting machines. In the former group is a machine which has not previously been shown at the Fair. This is the Avery-Brownsdon wear and lubricant tester, designed to show the relative resistance to wear of various metals and the relative efficiencies of lubricants in preventing wear. In each case a flat metal specimen is held by a known force against a hardened revolving wheel, the periphery of which is supplied with lubricant. After a certain time interval the specimen is removed and the length of the elliptical impression is measured. If the same metal be used with various lubricants then the impressions give relative properties of the lubricants to prevent wear; on the other hand, if various metals be used with the same lubricant the resulting impressions show the relative capabilities of the metals to resist wear.

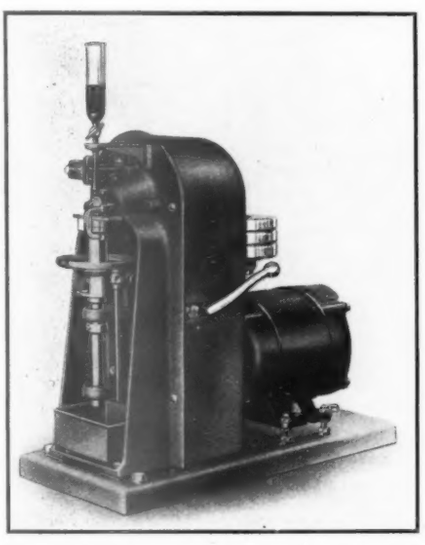

FIG. 1.—A NEW WEAR TESTING MACHINE BY W. & T. AVERY, LIMITED.

Amongst the other testing equipment shown are two universal-type machines of 10 tons and 50 tons capacity, an electrically-operated spring scragger, an impact tester, a direct-reading hardness tester for rapid tests, and a fatigue testing machine.

ELECTRIC FURNACES

Birmingham Electric Furnaces, Limited, Birlec Works, Tyburn Road, Erdington, Birmingham, have as their main exhibit on Stand No. Cb313/214, an electrically-heated brazing and bright-annealing furnace, but foundrymen will be much more interested in the models of the Birlec-Detroit rocking indirect arc furnace and the 'Lectromelt direct arc melting furnace. As the works of this company are quite close to the Fair, it is easy for visitors to see there full-size equipment.

OXY-ACETYLENE WELDING AND CUTTING

Stand No. D411/312 of the *British Oxygen Company, Limited*, of London and elsewhere, focuses interest on the oxy-acetylene welding and cutting processes. By practical demonstrations, visitors have every opportunity of seeing for themselves the advantages of B.O.C. equipment for their particular class of work. At the same time they can learn about the best method to adopt for the job they have in mind for the processes. Since every manufacturer's problems vary in nature and detail, it is manifestly impossible to describe the equipment, method and process which the technical staff would recommend in each case. All that can be done is to indicate the great possibilities open to the individual visitor himself to investigate on the grounds of efficiency and economy.

FIG. 2.—REPAIRING A CAST-IRON PAPER PULPER BY THE OXY-ACETYLENE PROCESS, USING BRITISH OXYGEN COMPANY EQUIPMENT.

In the foundry industry, for example, the British Oxygen Company's gases and equipment are of use almost, one might say, from the cradle to the grave. It starts with the cutting up of over-sized steel scrap for use in the furnace, the removal of runners and risers from castings, and the rehabilitation of slightly defective castings. For this last phase the "Alda" portable oxy-acetylene welding outfits are particularly well suited.

In the field of non-ferrous metals the company can be equally of service to the visitor. Their special research into the welding of aluminium and copper, for example, places them in a unique position to advise on the fabrication of plant and articles from these metals. Advice on the welding of Elektron, brasses, bronzes, zinc, silver and tin is available. With their extensive range of "Alda" welding rods and fluxes, the company is in a position to tackle almost any problem in non-ferrous as in ferrous welding.

GAS INDUSTRIES SECTION

The Gas Section consists of a comprehensive exhibit by the *British Gas Federation* and individual exhibits by over seventy of the largest manufacturers of gas appliances, etc., throughout the country.

Particularly timely is the factory heating exhibit. The Factories Act (1937) becomes operative in July this year, so that by next winter many factories will have to have new heating equipment, and with this in view this special exhibit has been arranged. The equipment on show includes low-pressure hot-water central-heating units, central air-heating units, unit air heaters, radiant panel heaters, convection heaters and steam boilers, and many types of automatic control gear for factory heating.

Working demonstrations include one of die-casting in aluminium-bronze. This demonstration is arranged by a large firm of die-casters whose factory is equipped throughout with town-gas fired furnaces. Other exhibits include a recirculated atmosphere enamelling oven and recirculated atmosphere tempering furnaces.

ELECTROPLATING EQUIPMENT

W. Canning & Company, Limited, Great Hampton Street, Birmingham, 8, on Stand No. Cb215, show a number of items of major interest to the foundry industry. Whatever castings have to be plated, foundrymen will find on this stand a complete range of plant for effecting this, and not only the actual plating baths, but also the various items of polishing machinery. Many of these are entirely automatic, such as one specially designed to handle small circular articles.

CRUCIBLE FURNACES

Engineering Service, Limited, 39, Carrs Lane, Birmingham, 4 (Stand No. D107), have two exhibits of interest to foundrymen. One is the Macrae Rapid crucible furnace, which was shown at the Foundry Trades' Exhibition last September, and the other a new type of sand mill.

PYROMETERS

Ether, Limited, Tyburn Road, Erdington, Birmingham, are showing on Stand No. Cb716 instruments which have been developed to meet the exceptional conditions which have existed during the past year. The enormous increase in aircraft production, combined with improvements in light alloys and more stringent limits in regard to heat-treatment and physical limits, has called for more extensive use of automatic control and recording of salt-bath and furnace temperatures.

The Ether "Indicorder" controlling recorder is shown in Fig. 3 arranged to control the temperature of gas and oil fired furnaces in conjunction with motor and solenoid operated valves. The motor-driven units also operate dampers and air supplies. The controlling recorder provides also an output and progress record of the furnace operation.

The Ether indicating controller is shown in Fig. 4, this instrument being used for controlling temperatures where no permanent record is required, the motor and solenoid operated valves being used in conjunction with them. These instruments also control electric-furnace tempera-

tures by operating the contactor coil without interposed relays. The Ether system of automatic control is distinguished by its extreme simplicity and high accuracy. A working model exposed to show its operation is exhibited.

The firm is much appreciated in the foundry industry for its molten metal pyrometers, which are extensively used by leading metallurgists all over the world. These instruments can be used for indicating the temperatures of all

FIG. 3.—THE "INDICORDER" CONTROLLING RECORDER SHOWN BY ETHER, LIMITED.

molten non-ferrous metals, and also low-temperature cast iron.

The Ether surface contact pyrometer is shown in operation. This instrument is used for taking the temperature of die-casting moulds, Duralumin billets, etc. A feature of the instrument is its rapidity of reading, the full temperature being shown in less than 10 secs.

A working model of Stevenson's Patent moving coil galvanometer, as used in all Ether thermocouple and resistance pyrometers, is shown. This movement is embodied in all the edgewise and round-type indicators, shown in various scale lengths from 3 in. to 12 in. The 12 in. Edgewise

FIG. 4. THE "ETHER" INDICATOR CONTROLLER.

indicator has the longest scale length of any make of indicator, and is appreciated on account of its accuracy and electrical characteristics.

Ether optical pyrometers of the disappearing filament and radiation type are also shown in operation. These instruments cover the temperature range from 700 to 2,400 deg. C. Other exhibits include low-temperature indicators and thermocouples for many applications. The chromel-alumel thermocouple is of considerable interest, as it is arranged so that users can replace burnt-out wires and sheaths in a few minutes, the various parts being electrically and mechanically interchangeable.

VITREOUS ENAMELS

The stand of *Ferro-Enamelling Company (England), Limited*, Ounsdale, Wombourne, Wolverhampton (No. B705), will be a centre of interest for vitreous enamellers, as it is the first time that this company has taken space. The major interest is, of course, the supply of enamel frits, and many examples are shown as finished vitreous-enamelled ware. Other exhibits include spray guns and furnace parts.

ELECTRICAL EQUIPMENT

Stand No. Cb517/414 of the *General Electric Company, Limited*, Magnet House, London, W.C.2, obviously has to make the widest possible appeal, and it includes material for domestic consumption. On the industrial side a special feature is made of samples from a new range of d.c. motors up to 200 h.p. for driving steelworks auxiliaries; a selection of a.c. motors for general industrial purposes is also on view, and a complete bright-annealing installation, including the furnace, switchgear and auxiliary plant, is in actual operation.

There is also a wide selection of Osram tungsten filament lamps for all lighting purposes and Osira mercury vapour electric discharge lamps for industrial lighting. Of special interest is the latest 400-watt Osira luminescent lamp, which, by providing a whiter light, considerably extends the field of Osira lighting.

REFRACTORIES

Gibbons (Dudley), Limited, Dibdale Works, Dudley, are again showing in the Gas Industries Section, and on Stand No. Ca511 is a full range of their well-known refractories, the various types available being sufficiently comprehensive to cover the bulk of industrial requirements. Silica bricks of the 95 per cent. SiO_2 type are exhibited in the form of squares, end and side arches, and special coke-oven shapes, the very accurate finish being a noteworthy feature. The "H.T.1" brand refractory insulating brick is prominently displayed both in the form of squares and special shapes, proof of the success of this material being shown by the fact that a complete new plant has been installed to cope with the increased demand. It is interesting to note that a rectangular kiln erected on the firm's own works is lined throughout with "H.T.1" and is giving a saving in fuel of nearly 50 per cent. compared with the ordinary firebrick-lined type. Various types of fireclay and aluminous materials are exhibited, and also a range of super refractories in silicon carbide, fused alumina and sillimanite.

Their associated firm, *Gibbons Bros., Limited*, include amongst their exhibits on the same stand illuminated illustrations of malleable-annealing and enamelling furnaces.

INDUSTRIAL MOTORS

Higgs Motors, Limited, Witton, Birmingham, 6 (Stand No. Cb617) are showing a range of new-type fan-cooled totally-enclosed electric motors which are particularly suitable for applications where standard motors are unsuitable. The general construction follows the well-tried principle of dissipating the heat from the windings by external forced-air cooling. The motor is totally enclosed from the atmosphere and mounted in an exterior shell which forms a duct for the cooling air from a fan driven by the motor itself. This fan, which is mounted on the motor shaft, is protected by a cast-iron cowling of pleasing appearance. A full range of these machines in both squirrel-cage and slip-ring types is being shown.

STOVES AND TUMBLING BARRELS

Silas Hyde, Greet Works, Evelyn Road, Sparkhill, Birmingham, 11, on Stand No. Ca702 include a number of exhibits of interest to the foundry, such as stoves for enamelling, lacquering and drying, degreasing plant and tumbling barrels.

DEGREASING PLANTS

Imperial Chemical Industries, Limited, of Imperial Chemical House, Millbank, London, S.W.1, are showing on Stand No. D305 three of the latest type of I.C.I. degreasing plants in operation. One of these, the gas-heated "V2" type, is fitted with an overhead gantry and electric hoist, and is designed for general degreasing requirements in the heavy metal industries. The other two are of the so-called liquor vapour type, in which the greasy articles are given a preliminary wash in boiling liquid solvent to remove grease and solid particles before passing on to a separate compartment for a final cleansing in vapour. They are a gas-heated "LV2" and a larger continuous gas-heated plant of the type supplied to various plating firms in the Birmingham area. These plants operate on a self-cleaning principle, and have been designed to satisfy the exacting requirements of the vitreous enamelling and electroplating industries.

ZINC AND ZINC ALLOYS

Stand No. D621 of the *Imperial Smelting Corporation, Limited*, 95, Gresham Street, London, E.C.2, is devoted to high-purity zinc. By the adaption of the basic chemical principles of liquid purification to a metal whose boiling point exceeds 900 deg. C., a process has been established which will produce in commercial quantities zinc of a purity exceeding 99.99 per cent. This metal—the purest on the market—is produced by the Corporation at their Avonmouth smelter, and is marketed under the registered brand of "Crown Special." Its importance is amply demonstrated by the exhibit. Illuminated spectrographic plates of "Crown Special," electrolytic, special purity and G.O.B. zincs can be examined in a viewing box, and the small impurities contained in each is shown by the variation in the thickness of line on the spectro.

A special feature has been made of one of the major uses for zinc—that of protection against corrosion. The value of galvanising in this connection is shown, and in particular the advantage to be gained by using heavy coatings. A practical exhibit of considerable interest to all users of galvanised sheets shows that the life of a galvanised coating is generally directly proportional to its thickness.

The main production of "Crown Special" zinc is required for the manufacture of "Mazak" alloys. The uniform composition of these alloys ensures that they are of ready castability with high mechanical properties, and, what is most important, are stable at low and elevated temperatures. These special characteristics are obtained because of the high purity of the zinc used in their manufacture. The small impurities present in ordinary zincs very seriously affect the stability of zinc-alloy diecastings. A very comprehensive display of diecastings in their various fields of application is shown.

A special section dealing with cadmium and cadmium bearing alloy is of considerable interest. Specimens are shown of bearings, large and small, which have been lined with this special cadmium bearing alloy. This bearing alloy has been developed primarily for use in high-duty bearings. The advantages of cadmium plating are well known, and interesting exhibits are shown on the stand of the particular applications.

GAS-FIRED FURNACES

The Incandescent Heat Company, Limited, Cornwall Road, Smethwick, Birmingham, on Stand No. D603/502, exhibit a deep recuperative furnace fired by town gas, suitable for all heating and heat-treatment operations up to 1,200 deg. C., and a special low-temperature heat-treatment furnace of the precision recirculating type fired by town gas and suitable for all temperatures up to 700 deg. C. This furnace is illustrated in Fig. 5. In addition, a number of small furnaces are being shown for various pro-

cesses, together with a complete range of photographs and literature.

An associated company, *Controlled Heat & Air, Limited*, have as their main exhibit one of their patent indirect-fired low-temperature core drying ovens, complete with independent heat interchange.

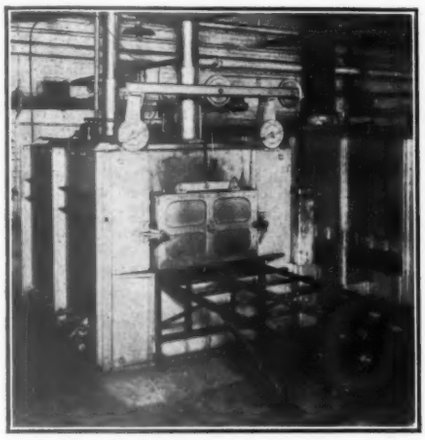

FIG. 5.—A GAS-FIRED LOW-TEMPERATURE HEAT-TREATMENT FURNACE BY THE INCANDESCENT HEAT COMPANY.

ELECTRIC FURNACES

Metalectric Furnaces, Limited, Cornwall Road, Smethwick, Birmingham (Stand No. D603 and 502), are showing an electrically-operated crucible furnace for melting aluminium and aluminium alloys, of the latest lip-tilting type, motor-operated. The windings are of unique design and of patented construction which allows the removal of the elements whilst the furnace is under temperature. Two types of muffles are shown, one of the portable box type for general heat-treatment purposes up to 1,000 deg. C. The second is a small robustly-constructed laboratory type furnace, also suitable for working at temperatures up to 1,000 deg. C.

For low-temperature annealing such as the heat-treatment of piston pots, there is a recirculated atmosphere furnace incorporating a patented fan.

A model of a Tagliaferri arc melting furnace of the three-phase type, for iron and steel melting, is of special interest, as at the moment one of 15 tons capacity is being installed at Jarrow. The exhibit is completed by a series of framed photographs showing the numerous types of furnaces manufactured.

BAND-SAW MACHINES

The Midland Saw & Tool Company, Limited, Pope Street, Birmingham, 1 (Stand No. B228), show a number of band-saw machines cutting up various non-ferrous, iron and steel castings, a line in which they have achieved a major success. The machines carry an automatic brazing apparatus so that, in the case of making a metal pattern, for example, a hole can be drilled and the saw threaded through, brazed up and then an internal portion accurately removed. There is also a display of patternshop saws of various kinds.

STOKERS

Mirrlees, Bickerton & Day, Limited, Hazel Grove, near Stockport (Stand No. B322) show stokers which are eminently suited for firing foundry furnaces, stoves and ovens. The actual plant shown is for central-heating boilers, but modifications are available for industrial uses, and the economy they have shown, because of an intelligent combination of automatic feeding and combustion control, has made them deservedly popular.

MELTING FURNACES

Monometer Manufacturing Company, Limited, Savoy House, 115-116, Strand, London, W.C.2, on Stand No. D728 have a 1,000-lb. capacity central axis tilting crucible furnace in operation as their principal exhibit. Amongst other furnaces is an oil-fired bale-out furnace for the aluminium foundry.

MAGNETIC SEPARATORS

The Rapid Magnetting Machine Company, Limited, Lombard Street, Birmingham, 12, on Stand No. Cb412 show a variety of magnetting machines which are now so familiar to users of mechanised sand-handling plants. A number of improvements have recently been effected, and those who did not visit last September's foundry exhibition should make a point of visiting the stand and familiarising themselves with them. Other items shown are lifting magnets and machines for dealing with brass foundry swarf.

PIG-IRONS

The Renishaw Iron Company, Limited, near Sheffield, on Stand No. D324 show pig-iron of Derbyshire quality, supplemented by an exhibit of special low-phosphorus and high-manganese iron particularly suited for the production of high-duty castings.

COLD-BLAST PIG-IRON

The Round Oak Steel Works, Limited, Brierley Hill, Staffs, have a number of iron and steel exhibits on Stand No. D615 and 514, among them being displayed a range of the famous Dud brand of genuine cold-blast pig-iron, as well as samples of special cylinder iron.

PIG-IRON

On Stand No. B517 and 416 of the *Staveley Coal & Iron Company, Limited*, Hollingwood, near Chesterfield, sand-spun, metal-spun and vertically-cast iron pipes are the principal exhibits, but there is included a comprehensive exhibit of Staveley pig-iron. This is characteristic of the Derbyshire quality.

REFRACTORIES

John G. Stein & Company, Limited, of Bonnybridge, Scotland, on Stand No. D303 show an extremely wide and important range of refractories. The great improvement in dimensional accuracy of "Nettle" and "Thistle" bricks is the factor which strikes one who has been out of the industry for two decades. Their excellence as high-grade refractories was established even before that. The sleeves, stoppers and nozzles shown are being used in increasing quantity in the foundry industry, and foundrymen would do well to study these, as quite often very roundabout methods are used, where a bottom-pouring ladle would be surer and more effective. A feature is being made this year of high-temperature insulating bricks.

ENAMELLING TO THE TRADE

The Sterling Manufacturing Company, Davis Street, Cubitt Town, London, E.14, have arranged their exhibits on Stand No. Ca706 to emphasise their position as vitreous enamellers to the trade. Prominent amongst the examples shown are reconditioned gas-cooker parts. Other examples are refrigerator linings and cooker splash and crown plates.

PIG-IRON AND GANISTER

Stewarts and Lloyds, Limited, of Glasgow, Birmingham, London and elsewhere, on Stand No. D501/400, show products ranging from raw ores to finished tubes. Entering intermediately are pig-iron and ganister. The former is shown, *inter alia*, as two working models of pig-iron springs which demonstrate the superior physical qualities of pig-iron of "S. & L." manufacture, while an ingenious arrangement of samples of pig-iron under a series of magnifying glasses enables their relative appearance and structure to be studied and compared with ease.

MACHINE-CAST IRONS

The Workington Iron and Steel Branch of the United Steel Companies, Limited, on Stand No. D512 and 613, show West Coast hematite irons made from the rich Cumberland ores. They are now produced, as dealt with elsewhere in this issue, by machine-casting, a process rapidly replacing the old sand-casting method. A full-length film in actual colour shows the manufacture of machine-cast irons, and the actual display of finished products is supplemented by a photographic screen comprised of pictures of the more interesting stages in the production of the irons. "U.C.O." refined irons have many special applications, and a range of these is incorporated in the display.

ELECTRIC FURNACES

Wild-Barfield Electric Furnaces, Limited, Elecfurn Works, North Road, Holloway, London, N.7, on Stand No. Cb303/204, show a wide range of different types of electric furnaces, including both industrial and laboratory equipments. There are a number of different types of muffle furnace included, from small tube furnaces to rectangular, oval and vertical ones. They are particularly suitable for laboratory work such as ashing, thermocouple checking, etc., but are also useful for hardening small tools where a large output is not required. Electric heaters for soldering irons will be on view. These heaters have shown their superiority over other types and are very widely used. Robustness, long life and low running costs are their essential features.

A tubular-hairpin furnace shown is similar to the "Heavy-Hairpin" furnace which has been in constant use for many years. The difference is that tubular elements are fitted which enable the furnaces to be used up to 1,150 deg. C. The essential details are the same as previously given, but several modifications have now been incorporated. These include concealed pneumatic door-operating gear, and closer fitting of the door when shut and also many other minor alterations which improve operating conditions.

The vertical forced-air-circulation furnaces are represented by two models, one intended particularly for tool-room work, but which can be equally well employed for production tempering where a small output is required, or for experimental purposes. The other model is the smallest production size and is fitted with a charge progress recorder, which combines an automatic temperature controller with a two-point recorder, one a record of the furnace and the other of the charge temperature, thus informing the operator when the charge has attained the desired temperature throughout.

A Vickers hardness testing machine is available for testing. As is well known, this machine is unrivalled for accuracy and the wide range of sizes and materials which can be tested.

Resistance to Trade Recession

An article on the industrial situation in the February issue of "Lloyds Bank Monthly Review" states that there is definite evidence that the country is displaying considerable powers of resistance against the general tendency towards a recession. The writer remarks that superficially the January employment returns seem disappointing, but if proper allowance is made for the fact that on the experience of the past five years the normal seasonal contraction between December and January is just over 200,000, the returns confirm the view that the recession has for the moment been checked. The recession in business since the early autumn, according to the "Review," has been very moderate and partial in character, several important industries having maintained their previous degree of activity. The January recession is stated to have been hardly more than could be explained by the normal diminution in activity which always follows Christmas.

D

Machine-Cast Iron*

By J. C. JONES

Machine-cast iron, as the name indicates, is iron that has been cast from the molten state to a suitable solid form by means of a casting machine. Casting blast-furnace iron by this method is not altogether a new idea, as it was originally tried out in this country approximately 40 years ago. At that time the practice of machine casting did not meet with any great success, and it was more or less abandoned.

The lack of success was chiefly due to two important considerations. First, the general design of the casting machine did not lend itself to reliable continuous "trouble free" working. Various difficulties connected with the pouring, cooling and mechanical maintenance were experienced, and, in addition, the amount of scrap wastage produced was excessive. Secondly, with smaller blast-furnace outputs, ample pig-bed casting space, and the pig-iron users' natural dislike of changes in established conditions, the opportunities for installing pig-casting machines were not too favourable.

On the other hand, there are to-day very different conditions which favour the adoption of casting machines. The modern casting machine is of an up-to-date design, and capable of overcoming the various difficulties which were associated with the earlier machines. It can also be stated with confidence that the majority of pig-iron users are more progressive and gladly welcome a step forward, rather than view it with suspicion.

Casting iron by means of the casting machine presents several advantages to both the producer and consumer. It is proposed first to indicate the advantages to the producer, and the advantages to the user will be dealt with later in the Paper. There are several important reasons connected with the production side of blast-furnace iron which favour and, in some cases, necessitate casting the iron by a machine. To illustrate this feature one has only to note the trend of modern blast-furnace design.

The tendency is to build blast furnaces with a larger productive capacity, and the increased tonnage of iron produced demands rather different methods of handling in order to ensure continuous and successful working of the blast-furnace plant. For instance, a modern blast furnace producing about 400 to 500 tons of iron per day will cast approximately 80 tons every four hours.

Casting the iron in sand-moulded pig-beds requires a fairly large area of pig-bed space, and even if there was unlimited space, there would be the problem of getting the molten iron to run the required distance necessary for an 80-ton cast. Certain irons with special analyses, such as high-silicon, graphitic and low-sulphur and phosphorus grades would further accentuate this feature. Also, running the iron over large areas increases the tonnage of runners or channels through which the molten iron passes when casting. Considerable time and labour is required to cool, break and remove these runners. The amount of sows made is also greatly increased, and it is unnecessary to stress the fact that they are heartily disliked by foundrymen. The runners can only be considered as remelting scrap, thereby increasing production costs.

The above only refers to the conditions at a single-unit blast furnace, but if the plant comprises two or three blast furnaces it will be seen that greater difficulties will be met in cooling and clearing the pig-beds in time for re-moulding and casting.

In this country, it is usual to find that blast furnaces have their casting beds in the open air and exposed to varying climatic conditions. During extremely wet periods there is an excess of moisture in the moulding beds, and when the molten iron is run down the beds minor explosions or "boils" often occur. These "boils" are a source of danger to the workmen, and in addition they eventually form irregular masses or lumps that are not in a suitable physical state or size for marketing to consumers. These lumps also entail extra labour and cost in breaking up for internal use as scrap. Unless the blast furnaces are associated or connected with some other plant such as cupolas or open-hearth furnaces, the disposal of this unsaleable product presents further difficulties and increased production costs.

It is not considered advisable or practical to return this material to a modern type of blast furnace for remelting. The newer type of blast furnace is equipped with intricate mechanical charging apparatus and the scrap is liable to foul or damage the working parts, thus causing serious delay or stoppage to the plant.

Pig Casting Machine Details

The casting machine described in this Paper is the one in use at the Workington branch of The United Steel Companies, Limited. The design is of the double belt or strand pattern; the structure is made of standard steel sections and consists of two travelling belts of cast-iron moulds. The moulds are attached on either side to a built-up chain consisting of manganese steel wheels or rollers and connected by suitable links. To these links are attached the cast-iron moulds in a continuous unbroken line. Each pair of chains (which travel on standard section rails of about 2 ft. 6 in. gauge) is connected to the moulds to form a strand.

It is important to have the arrangement of the chains and attachments properly designed for rapid and easy changing of broken moulds without serious disturbance of the mechanism.

There are 300 moulds on one side and 292 on the other, the reason for this difference being to allow each strand to have its own loading shute. Thus each strand is absolutely independent of the other throughout, and simply by blocking or stopping one of the spouts of the "T" runner and preventing the flow in that direction, the remaining strand only may be used.

A further advantage is gained in that the iron is distributed and spread over the truck into which the iron is being loaded. The truck need only be moved once during loading. A 20-h.p. variable-speed motor with a suitable reduction gear (enclosed in a cast-iron oil-tight casing) drives the endless strands through the upper sprockets. The strands pass over the upper sprockets and over the lower sprockets at the lower or pouring end of the pig-casting machine.

The operator in the control box has a full view of the pouring, spouts, lower section of moulds and the position of the ladle containing the molten iron. He also controls the speed of the machine, which may be varied from 20 to 35 ft. per min. The variable speed of the machine enables a smaller size of pig to be made and by means of the bridge in the centre of the mould, together with increased belt speed and decreased pouring speed, this can be accomplished. A full slab weighs about 110 lbs.; the notch in the centre is covered by about 1 in. This permits easy breaking of the cold slab by means of a drop of about 3 ft. on a suitable block. This is particularly useful to users of strong, tough West Coast hematite iron.

After the iron drops from the moulds into the loading trucks, the moulds return, the inside facing downwards. Lime wash of a predetermined quality is sprayed on to the inside of the moulds. The lime wash prevents the pig from adhering to the mould, and is thus a very important part of the casting process. At a suitable position, just about when the empty moulds have made half the return journey, lime spray vats are installed, where the lime wash is suitably mixed. The lime is sprayed by means of steam through suitable nozzles.

FIG. 1.—GENERAL VIEW OF MACHINE-CASTING PLANT AT WORKINGTON.

Each lime vat, when full, contains sufficient lime wash for 50 tons of iron, the lime being constantly agitated by means of air in the bottom of the tank. There are flush valves at the bottom of the tank, and when these are opened the lime wash can run back into the mixing tank, where it is stored until required for use again.

In the early days of casting machines, considerable trouble and difficulties were experienced through excessive scrap production, and heavy labour costs for mechanical maintenance. The troubles were mainly due to the type of ladle used, which was generally of the "long pour" variety. This type of ladle required the elevation of the pouring end of the machine to be at yard level, the steel structure and moving parts, etc., being built in a pit.

When ladles of this type were being poured, the fall of the hot metal into the pouring box caused considerable splash, producing heavy scrap losses, and some of the metal was deposited on the track, which prevented the rollers or wheels from rotating. This caused excessive wear to these rollers and, of course, extra power con-

* A Paper read before the Sheffield Branch of the Institute of British Foundrymen, Mr. J. Roxburgh presiding. The author is on the staff of the Workington Iron & Steel Company, Limited.

sumption. It is not difficult to imagine the trouble experienced in clearing this scrap deposit out of the pit on account of the inaccessibility. The pits often became so blocked up with scrap that continuous working was interfered with.

Fig. 2 shows the type of ladle used at Workington. The ladle is of 60 tons capacity and is shown being tilted; the tilting horns engage on the pouring stand, giving short pour effect. This design of hot-metal ladle is fitted with triple trunnions and heavy castings terminating with pouring horns that engage on the pouring stand. When the ladle is tilted the inner trunnion is engaged and the centre of the ladle advances. When it is further tilted, the pouring horns engage the ladle stand and become the centre of rotation. The pouring lip is now practically in a fixed position, thus giving a fall into the runner of less than 12 in., which eliminates to a great extent the scrap production and spillage of iron that was common to the older types.

The tilting of the ladle is controlled by the operator in the control box, from which position he has a full view of the operation. The molten iron is poured and flows along the runner and is divided by the "T" shaped trough where it runs into the moulds on the strands. It is sometimes impossible to fill the moulds equally on both strands with this trough, but the operator, having the speed control at hand, and each strand being separately controlled, adjusts the speed to take care of this.

From the centre of the head to the pouring end is a distance of about 140 ft., and when the iron in the moulds has travelled about 70 ft., fine water-sprays play on the moulds until they reach the head or discharge end. The moulds travel over the sprockets, and as the pigs fall out they are guided into a shute by a spring-loaded guide and so into the loading truck. The spring-loaded guide allows movement in the event of two slabs falling together and jamming, thus preventing damage to the strand.

Undoubtedly the short-pour ladle has done much to make present-day machine casting a success. The larger the ladles are, the better, but it is possible to fit smaller ladles with short-pour horns and thus bring about the short-pour feature so necessary to the successful performance of the casting machine.

The most suitable wagons into which the iron is discharged from the machine are made of steel and are of 50 tons capacity. The stacking of machine-cast iron should present no difficulties. A wall of full-size slabs can be built and the enclosed area used for stacking iron. There is no reason why a larger amount of iron cannot be stacked in less area than that required by sand-cast iron, and with less handling costs.

FIG. 2.—60-TON LADLE WITH TILTING HORNS ENGAGED ON POURING STAND.

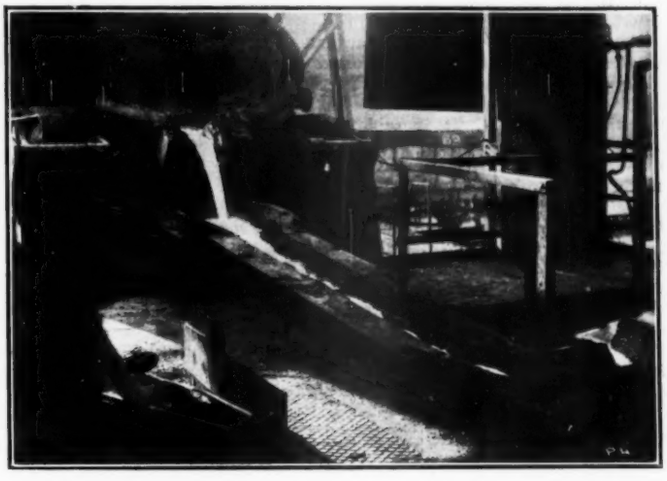

FIG. 3.—LADLE POURING MOLTEN IRON INTO RUNNER. THE SHORT POUR AND ABSENCE OF SPLASH SHOULD BE NOTED.

FIG. 4.—MOLTEN IRON FLOWING DOWN RUNNER, THROUGH "T"-SHAPED TROUGH, INTO TRAVELLING MOULDS.

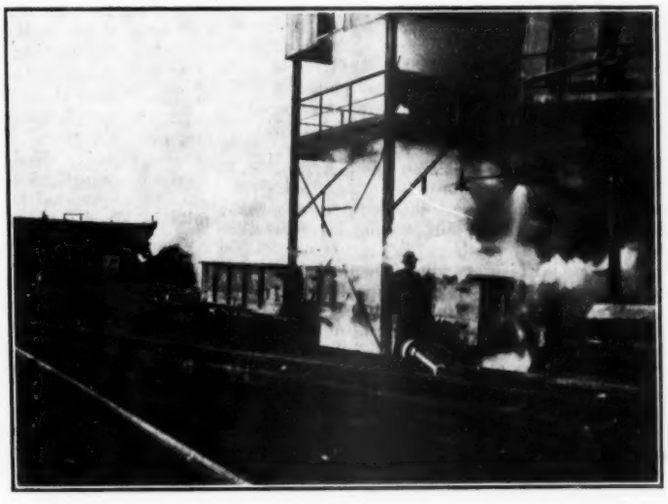

FIG. 5.—STEEL LOADING TRUCK AND WATER SPRAYS COOLING THE IRON.

Advantages of Machine-Cast Iron

It will be agreed that the general appearance and physical state of machine-cast iron are an improvement on the sand-cast variety. Machine-cast iron is clean and free from sand; thus the consumer obtains 100 per cent. iron. Sand-cast iron has a coating or skin of "fused-on" sand, which is of a very refractory nature. This refractory skin covers about 50 per cent. of the total area exposed to the melting action in the cupola and is fluxed at the expense of extra fuel. Machine-cast iron presents 100 per cent. clean metal surface to the action of the melting influences in the cupola.

The absence of the refractory skin enables a reduction to be made in the amount of limestone used, with a corresponding reduction in the quantity of slag produced. There is also a considerable saving in fuel cost. A certain foundry engaged on the manufacture of ingot moulds reports that, when using ordinary sand-cast pig-iron, the coke consumption averaged 2 cwts. of coke per ton of casting. On turning over to machine-cast iron they obtained a figure of 1.72 cwts. of coke, a saving of approximately ¼ cwt.

Another foundryman who is now using machine-cast iron states that he obtains an increased wearing life of the cupola lining. The size and shape of the machine-cast iron lend it

to easy handling, and in foundries where the cupola charge is not actually weighed the approximate weights of the iron charges are more accurately estimated than in the case of sand-cast pig-iron, which does not always break into uniform sized pieces. Although it is now usual to purchase pig-iron to specified analyses, there are still some users who desire to view the fracture structure of the iron they use in their furnaces. In machine-cast iron, there is a breaking notch about 1 in. thick, and where the iron is broken at this point, the fracture can be seen.

Regarding the question of fracture, it is of interest to note that numerous foundrymen who have had a life-long experience in the foundry specify a close grain fracture in the iron supplied to them. It is said that the open grain, large graphitic flaked iron is not so suitable for most of the castings made, and is more or less responsible for spongy, porous and dirty castings. The close grain fracture desired by the foundrymen is often obtained by the supplier selecting iron from the stockyard, and it may be picked from different casts with variations in the analysis. These selected pigs do not always show the same fracture throughout the length of an individual pig. There are numerous instances where a pig four feet long has been broken into several pieces and a different fracture found at each breaking point.

TABLE I.

Method of taking samples.	A furnace.		B furnace.		C furnace.	
	Si.	S.	Si.	S.	Si.	S.
Usual three samples from each cast ..	2.06	0.022	2.75	0.022	2.28	0.016
Samples from each bed—						
Highest	2.24	0.028	3.03	0.026	2.42	0.028
Lowest	1.82	0.018	2.70	0.016	2.19	0.010
Variation, per cent.	0.42	0.006	0.33	0.010	0.23	0.010

Another point to note is the fact that the close grain No. 3 iron is more easily selected from the high sulphur grades of iron, which has the tendency to be harder and less machinable. As the rate of cooling or solidification influences the size of the graphitic flakes formed, it will be understood that the rapid cooling that the machine-cast iron is subjected to, will tend to reduce the size of these flakes.

The state of the carbon in machine-cast iron is in a more finely diffused form and, consequently, a closer grained, stronger iron is obtained, which is less likely to cause sponginess and porosity. Moreover, the analysis is more uniform and a close grain iron is obtained without having to resort to high sulphur or unusual analyses, thus preserving good machinability.

Taking the chemical side of the question, it is found that machine-cast iron has definite advantages, probably the most important being the regular and uniform chemical composition. Sand-cast iron as run direct from the blast furnace into the pig-beds is far from being uniformly consistent in chemical analysis throughout a cast. In order to ascertain what variation existed in a cast of pig-iron run direct from the blast furnace into sand pig-beds, the following tests were undertaken.

Three different blast furnaces were selected for the tests. Three casts of pig-iron, one from each furnace, were sampled by two methods. The first method was the usual three samples being taken as the molten iron was filling the beds.

The first sample was taken from the runner at the commencement of the cast, the second sample about half-way during the cast, and the third and last one near the end of the cast. Borings were then taken from each of the three samples, mixed and analysed. The analysis, which was really an average of the three samples, was eventually reported as being representative of the composition of the whole cast.

It will be noted that unless individual truck analyses of the iron are supplied to the users, it may lead to differences in analyses between the sellers' and buyers' chemists. For example, if one takes the case of a customer receiving delivery of an odd truck of iron from part of a cast, he may possibly find a different composition from the cast analyses supplied, in all good faith by the seller of the pig-iron.

The second method of sampling was to take separate samples from every bed of iron in each of the three casts. The casts were about 35 tons weight, each bed about 2 tons weight. This involved about 18 samples from each cast, and Table I shows the results of the tests.

When three casts of machine-cast iron were sampled, totally different results were found. Numerous samples taken at random from each of the three 50-ton casts showed a uniform analysis throughout each cast. The variations in analysis were so slight that they could be regarded as laboratory tolerances. It is quite natural to expect better uniformity if one considers the fact that in the time machine-cast iron is tapped from the blast furnace into a 60-ton ladle, transported to the casting machine, tilted and poured, it has undergone a thorough mixing.

A COLOUR FILM

Following the presentation of Mr. Jones' Paper, a coloured film, illustrating the manufacture of machine-cast pig-iron at Workington, was exhibited by MR. A. W. SWAN, Publicity Manager of the United Steel Companies. Mr. Swan, who took the photographs for the film, explained that it was in Kodachrome, and was the first completely edited engineering film in colour to be shown in Great Britain.. It was originally exhibited at the Foundry Trades Exhibition in September.

MR. JONES, explaining the film, said it was taken at the Workington Iron and Steel Works, and had been loaned by the United Steel Companies' publicity department. The film embraced the manufacture of cast iron from the raw material stage to the finished cast iron passing through the casting machine into the loading trucks.

The first "shots" depicted a stage in the manufacture of the coke that is used in the blast furnaces. A "push" or charge of red-hot coke was seen being discharged from the coke ovens and then conveyed to the quencher. This coke is made from coal mined at the company's own pits in West Cumberland.

The next view showed the crushing machine, where the iron ore is crushed into uniform sizes before being taken to the blast furnaces. It is important in blast-furnace practice to have a uniform standard of raw materials both in chemical and physical qualities. If the charged materials are too irregular in size, the reduction is also irregular. The modern trend is, therefore, to grade, screen and size the raw materials.

The question of uniform distribution of the charge and the problem of keeping the furnace well filled is equally important, and great progress has been achieved in this direction by mechanical chargers and rotating bells at the furnace top.

A large proportion of the ore is drawn from the company's hematite iron ore mines in Cumberland. Approximately, it requires about two tons of ore, one ton of coke, and half a ton of limestone to produce one ton of iron and half a ton of slag. Thus, it will be noted that a blast furnace making 400 tons of iron daily has to handle and cope with about 2,000 tons of solid material, in addition to vast quantities of air (blast) and gas.

The next operation showed the tapping, or "running off" the slag and iron. The molten metal in this instance is run into large cast-iron ladles, taken to the casting machine and poured into the travelling moulds. The film continued by showing the moulds travelling up to the head of the machine and finally being ejected down the shute into the loading trucks.

Concluding, Mr. Jones expressed the hope that he had succeeded in proving that machine-cast iron was of advantage to both producer and consumer. He also expressed his thanks to the United Steel Companies, Limited, for assistance in supplying the films and slides.

Institution of Works Managers

The Institution of Works Managers, which is at present in process of formation, will work to raise the status and prestige of the works manager. The provisional Council proposes to limit the membership strictly to those whose credentials prove both their experience and their capacity.

It is considered that, as a rule, candidates will be expected to have followed some regular course of technical training. As this will vary widely in different industries the Institution does not propose to set up examinations of its own. In addition, practical experience in works management will be regarded as essential, as only in this way is it possible to learn the psychology of handling workmen.

The need for the Institution has long been evident. The works manager occupies a key position in industry, but his importance has not received proper recognition. In recent years, also, added responsibility has fallen on the shoulders of the works manager from the fact that most types of manufacture are being conducted on a larger scale than formerly.

A preliminary letter has been addressed to the works managers of many of the most important firms in England, Scotland, Wales and Northern Ireland, and has met with a very encouraging response. Although, in the main, members will be in control of the larger units in industry, the Institution will give an equal welcome to the managers of small works if their personal qualifications are suitable.

It is proposed that the headquarters of the Institution shall be in Manchester, as this city is a convenient centre for the industrial north, and some of the most active support has come from this area. It is felt that it will be an advantage to keep in very close touch with industry. Membership will be in two grades, termed the Fellowship and the Associateship. The rate of subscription has not yet been fixed, but will be kept as low as possible and will probably be two guineas for Fellows and one guinea for Associates, with entrance fees of the same amounts. It has been suggested that all elected before the end of 1938 should rank as foundation members and should be excused entrance fees. Fellows will have the right to use the initials F.I.W.M., and Associates those of A.I.W.M.

Works managers and assistant works managers who are interested are invited to communicate with the Acting Secretary, Mr. L. M. Angus-Butterworth, F.C.I.S., A.M.I.Mech.E., Ashton New Hall, Ashton-on-Mersey, Cheshire, who will be glad to send reports of further progress. Technical directors in charge of works will be eligible for membership.

MR. JAMES BUSSEY, a local director of Thos. W. Ward, Limited, Sheffield, has been elected a director of the Midland Iron Company, Limited, in succession to the late Mr. Arthur J. Ward.

Patternmaking and Moulding

NEW LIGHT ON OLD PROBLEMS

At the January meeting of the Lancashire Branch of the Institute of British Foundrymen, MR. S. A. HORTON, of Derby, read a Paper entitled "Patterns and Their Relation to Moulding Problems." Mr. H. V. Grundy presided, in the absence of the Branch-President, Mr. R. A. Jones, through illness.

Mr. Horton's Paper, which had previously been presented to the East Midlands Branch of the Institute, was published in the JOURNAL for December 31, 1936, and January 7, 1937.

Vote of Thanks

The Paper having been read, MR. R. A. MILES proposed that a hearty vote of thanks be accorded to Mr. Horton. He remarked that the information concerning measurements, and the means of obtaining measurements, would be of considerable service to foundrymen generally. There was a real need for co-operation between the foundryman and the patternmaker. It was very difficult to make castings with a fair machining tolerance, when patterns were sent to a jobbing foundry from a jobbing patternmaker's shop.

Taking Dimensions

MR. E. LONGDEN, seconding the vote of thanks, stated that moulders were not always blameless in such matters. Perhaps, when patterns came from jobbing patternmakers to jobbing foundries, not a great deal could be done, because the training of the patternmaker who was out of association with the foundry was difficult. It was necessary to make the best of jobbing foundry patterns and alter them to suit individual requirements. Nevertheless, not all foundrymen in foundries associated with patternshops were helpful before a pattern was commenced. Foremen and moulders should try to understand more about drawing for large castings. Some of the sketches and figures relating to the contraction of small castings were interesting; they probably referred particularly to malleable iron castings.

MR. HORTON said that they were all derived from malleable iron castings.

MR. LONGDEN observed that the difficulty of measuring any type of small casting must be very great. He was not questioning for a moment Mr. Horton's conclusions. Mr. Horton seemed to have satisfied himself that the inaccuracies as between one type of small casting and another did exist. Probably a large number of average castings had been tested in each case. However, it was doubtful whether it would be possible to measure black castings of small design and compare one with another, there being so many variables in the production of the casting.

Mention had been made of certain batches of castings passing through the machine shop, some being well suited for jigging and some not. This was a point cited to prove the difficulty of measuring small castings. In carrying out experiments in the measurement of castings, his own experience showed that it was necessary to test a very large casting in order to be able to judge the difference between one class of casting and another. There were differences of contraction in different bodies of metal, considerations of bulk as against slenderness, etc., as well as cored jobs as against simple mass. If such conclusions were correct regarding small castings they would apply more particularly to white iron castings, rather than to grey iron castings, where there might be mass and thinness, and considerable expansion of one section against another which would pull the castings.

MR. HORTON, responding to the vote of thanks, assured Mr. Longden that the variations he had illustrated were carefully measured. The firm with which he was associated produced thousands of such castings for the motor-vehicle industry, and they were restricted to limits of $\frac{1}{32}$ in. It was not to be understood that the results were due entirely to the use of sea-sand cores, but the variation was due to the method of moulding used to produce the different types of design.

The CHAIRMAN said that after reading the printed report of a Paper presented by Mr. Horton at the East Midlands Branch he assumed that the attitude of the author would be one of complete defence of the position of the patternmaker and of the usual criticism of the inability of the moulder to work to the patternmakers' results. Instead of that, Mr. Horton had shown himself very sympathetic towards the moulder, and critical of the patternmaker's work.

Care of Aluminium Patterns

MR. J. A. REYNOLDS mentioned a difficulty in connection with aluminium patterns. What did Mr. Horton do when working under conditions where the atmosphere was damp, and it was impossible to heat the pattern? The usual complaint made against aluminium patterns was that they "clagged." Was it Mr. Horton's practice to polish the pattern, or had he any finish he could apply which would eliminate the trouble?

He assumed that the sea-sand cores referred to were oil-bonded, as contrasted with clay-bonded sand. Was it found that the normal contraction would apply if the sea-sand oil-bonded core was thoroughly baked so that it was a rich chocolate brown, that is, when it was just at the point when there was danger of crumbling? If it was not thoroughly baked it would be found to be brick hard, and consequently would hamper casting contraction, but there would probably not be the same difficulty if it was thoroughly baked almost to the point at which there was danger of it being burnt.

Referring to his experience with grey iron castings, Mr. Reynolds said that with long narrow castings, say 4 ft. 6 in. to 5 ft. long, and only $\frac{5}{32}$ to $\frac{3}{16}$ in. thick, it was necessary to allow much more for contraction than in the case of a lumpy casting, such as a bush. He actually allowed, in some cases, $\frac{5}{32}$ in. per ft. contraction for castings 5 ft. long, if they were thin; and $\frac{1}{10}$ in. per ft. in the case of bushes, from a few inches to 1 ft. dia., with a core perhaps $1\frac{1}{2}$ to 4 in. dia. It was found that in the case of cores for heavy bushes it was necessary to work to the standard rule, that is, allowing no contraction, while on the outer diameter the contraction was nearer $\frac{1}{10}$ in. per foot on an uncored blank. He was, of course, only referring to grey iron, and not malleable.

Prevention of "Clagging"

MR. HORTON said he had experienced clagging of aluminium patterns. Usually, before the patterns were put on the moulding machine they were heated slightly, and, if possible, a gas jet was placed beneath in order to keep them just warm. This could not be done with a double-sided pattern. It was not advisable to store aluminium patterns in a damp atmosphere.

When baking the cores, the foundry executive considered that the cores used were quite satisfactory. They did not like to have a core baked to such an extent that it would crumble, because one would soon get a wash and other difficulties in the core itself. With a different type of casting there was a different type of variation. He had purposely selected this type of casting in order to show that it was not always the variation of section and design which caused the difference in contraction; similar results appeared on similar designs due to moulding methods.

Contraction Data

MR. H. J. HOWE observed that he made the ordinary contraction $\frac{1}{16}$ in. per ft. for malleable iron, in the case of lumpy castings. Taking the contraction generally, he worked to $\frac{1}{10}$ in. for iron. At the present time, for nickel cast iron, he was allowing $\frac{1}{16}$ in., and in the case of orders where the castings were about 9 or 10 cwts. apiece and some 6 ft. long, one casting was sent for check. The variation in length probably did not exceed $\frac{1}{16}$ in. on a standard rule on the finished casting. Some finished jobs in aluminium, with $\frac{3}{16}$ in. of metal, and 6 ft. long, were done to $\frac{3}{16}$ in. to the ft., and he did not think there was $\frac{1}{16}$ in. variation.

With regard to core boxes, the contraction allowance varied according to the foundry. His firm sent to jobbing founders, and at one foundry he believed they made all the core boxes to standard size, but his firm definitely made their own to contracting sizes. The frames varied from half a ton to 35 cwts., whilst a few were over 2 tons. They had to be made so that they would turn over. They tried to cast the outside face downwards, so that everything had to be turned over, and there had to be a square pattern. If the moulder was careful the casting would come out easily.

Reference had been made to a patternmaker putting in $\frac{3}{4}$-in. screws. He had put rapping plates fastened with 3-in. screws, six on a frame 6 in. long, 3 in. wide, and $\frac{1}{2}$ in. thick, and all six screws had shifted. He had sent two frames to two different foundries, and one came back carrying a $1\frac{1}{2}$-in. hole, while in the case of the other it was hardly noticeable where it had been spiked.

His firm also produced a number of cylinders 6 or 7 ft. long, and they were all short. He complained to the foundry foreman, and they went to the pit to ascertain what exactly was happening. The foreman explained that the man working on the job had a board and a rod, and he had a chalk mark on his rod; but the man was not working to a pencilled line but to a chalk mark $\frac{1}{2}$ in. wide.

They had had some trouble at the foundry with cores. Some of the patterns were from Chicago, and were perhaps 2 in. thick outside and 4 in. wide all round. Definitely, if the result would not come true, the onus was on the patternmaker and not on the moulder. If a job was complicated it was usually useless to go to the moulder, because he did not understand the least bit about it.

Drafting Knowledge Unnecessary

MR. HORTON thought that the majority of patternshops were not sufficiently interested to have the first casting produced for the purpose of checking. A number of patterns were sent to foundries with rapping plates which were not suitable for the type of pattern. The purpose of a rapping plate was to assist in the withdrawal of the pattern from the mould. His firm had received patterns weighing $\frac{1}{4}$ cwt. with 1-in. or $\frac{3}{4}$-in. screws holding the rapping plate down, which was ridiculous. He agreed that the case mentioned by Mr. Howe was an unfortunate one, but nevertheless he, the speaker, did receive patterns without rapping plates.

He thought that Mr. Howe rather supported him by stating that the moulder did not understand the drawing. In a sense, he should not really do so. If he were given a pattern to use, that pattern should be foolproof. He should be able to produce a mould without having to resort to a drawing. If a core print could vary, so that a core could vary in a mould, it was not the moulder's fault. It was the patternmaker's fault for producing a corebox that allowed $\frac{1}{2}$ in. variation between core and core-print size. The patternmaker should endeavour to produce a pattern equipment that was foolproof. A moulder could not afford to spend his time checking over a core to ascertain whether it was in correct position; when a core was in a mould it should be set. Generally speaking, there should be no need for measuring up with core gauges or anything else. A pound spent on a pattern in a patternshop would sometimes save £10 in the foundry. They were all familiar

with the old type of moulder who had to set a job to a gauge. He had a look at his gauge, then at the job, and then perhaps had a walk round the foundry looking for the foreman before he tried his gauge.

MR. HOWE remarked that one of his greatest troubles at present in regard to contraction was in the case of steel. He had had $\frac{3}{16}$ in. allowance, and then the casting had come short, so that now he was allowing $\frac{1}{4}$ in. to the foot.

Plywood Patterns

MR. F. ANDREW inquired if Mr. Horton had had experience of plywood patterns. He himself had had plywood patterns supplied, and then people wondered why the castings were not straight. Everybody appeared to have the idea that plywood would not go crooked.

Loose pieces should be avoided wherever possible. They should be made into "D" bosses; or one-half of the boss should be on the pattern and the other half in a core, and then one would know when the core had been set right without waiting for the machine shop.

He had been trying to eliminate rapping plates for some time because they were a nuisance. In one instance a good pattern costing £14 or £15 was knocked to pieces with a rapping bar. He gave instructions that there must be no rapping plates put on the new pattern, but that there must be four screw plates at the corner for small lifting screws, the only rapping necessary being done by the men when drawing the pattern.

MR. HORTON said he had to deal with a number of plywood patterns, but, whenever possible, he liked to have plywood patterns mounted on a board. They did not keep straight unless they were battened. Plywood was not so suitable for patterns as some people imagined.

Taper

MR. ANDREW inquired whether Mr. Horton had known cases where the patternshop made it a general rule to put the taper on the patterns; also, of any specialised work where the contraction was not likely to be very much and where the contraction dimensions were put on the drawing.

MR. HORTON, referring to pattern taper on drawings, stated that 75 per cent. of the castings made by his firm were used by the motor industry. Nowadays, the designers of motor castings were incorporating taper on the drawing, and they usually tried to indicate some idea where the job should be jointed, so that D-shaped bosses could be used wherever necessary. His firm were dealing with merely one material, but this involved the use of a series of various contractions due to the variation in casting design and method of production.

Rapping Plates

MR. J. A. REYNOLDS said that much damage was caused from time to time, not so much due to rapping plates or the lack of them, but in lifting out the pattern, especially when the pattern had very little taper or was heavy. A good plan was not to have any lifting straps, which were very often in the way, but to have a hole or holes drilled into the pattern, which was lifted out with an expanding eye bolt of the Estler type. On screwing, the bolt expanded tightly in the hole, and it was quite an easy matter to remove the pattern.

MR. HOWE remarked that another good plan was to use a mixture of shellac varnish and plumbago.

MR. J. E. COOKE said that the tendency of the discussion had been to place the patternmaker on the defensive. Generally speaking, with a Paper of this type, the meeting resolved itself into two warring elements, each accusing the other of all sorts of shortcomings. Mr. Horton had at any rate done something to enlighten them in respect to one another's difficulties. In regard to taper, it would be of considerable service to the moulder if the patternmaker realised the difficulties attendant upon the closing of a mould at the last minute when perhaps metal was waiting. The patternmaker liked to have a square surface to work from, and quite often forgot to put on taper afterwards, resulting in sand being carried down into the mould. It should be generally realised, however, that the patternmaker had his own difficulties in construction.

Core Size Variation

Cores varied very considerably according to their bulk. There might be sea-sand cores with a very similar form of binder dried under identical conditions; nevertheless, a very slight variation in their bulk would alter their resistance power considerably. Whereas the arrangement for contraction with one might be satisfactory, a core of larger dimensions would be found unsatisfactory.

Another point which should be taken into consideration, though not so generally experienced in connection with sea-sand cores, was the number of irons and the position of the irons in the core. Where moulders liked to have irons as near as possible to the ends of the core, it had been found quite frequently that the resistance of the core irons themselves was more important than the resistance of the sand within the core. He had seen many tests carried out which definitely proved that under the conditions of the stoving of the cores, however well the operation was controlled, there was actual expansion of the irons.

Closing Allowances

Mr. Horton had not mentioned the closing-over allowance on top parts of the core. There was the possibility of making an allowance so that when the top part was put on, the core print recess was formed by a core print which only touched and secured the core from movement when it was down, but was free until it was actually down. Closing allowances made either at the sides or the ends were extremely useful for the moulder.

Another point of importance, both to the moulder and the patternmaker, was knowing how the core was going into the mould and of making adequate allowance for it. One quite frequently saw patterns with core prints occupying boxes where there was not sufficient space to allow the moulder to get hold of the end of the core to drop it into the mould. Quite frequently hooks had to be inserted, and two men had to steady the core to insert it. If some provision was made for the moulder to get his hands down the mould space, he had an opportunity of not only doing the operation more accurately, but incidentally of expending a good deal less labour.

MR. HORTON expressed general agreement with Mr. Cooke's remarks. He believed there was variation due to different moulders rapping different patterns. The patterns he had chosen were machine moulded, and he had purposely chosen them owing to the fact that the unevenness of rapping would be eliminated to a great extent.

At the conclusion of the discussion Mr. Horton stated that it seemed to be assumed the moulder could not understand a drawing. His experience was that the majority of foundry executives had a working knowledge of machine drawing, though perhaps not to the same extent as a patternmaker. They did, however, understand a drawing to the extent of saying, "We will have a joint here, and a taper here." The belief that the foundrymen did not understand a drawing was no longer correct.

Soviet Order for Steelworks Plant

The Soviet Government has placed with the Davy & United Engineering Company, Limited, Sheffield, a big order for the construction of steelworks plant and machinery. In addition to a large forging press, the order comprises a hydraulic plate bending press with mechanical handling equipment, and a 4-high reversing mill for cold-rolling steel strip.

Desulphurising in the Blast Furnace

Report of Investigation No. 3357 issued by the U.S. Bureau of Mines contains the following notes relating to the mechanism of desulphurisation.

Since the manufacturer of steel has been forced to meet more exacting specifications, due to the more rigid requirements demanded of steel by the consumer (states the Report) it is desirable to remove as much as possible of the sulphur in the blast furnace.

The first step in desulphurisation is accepted as being the result, chiefly, of the reaction

$$CaO + FeS \rightleftharpoons CaS + FeO \qquad (1).$$

Other bases, such as MnO and MgO, may react to a lesser degree.

In the presence of carbon, another reaction plays a significant part,

$$FeO + C \rightleftharpoons Fe + CO \qquad (2).$$

If reaction (2) were allowed to proceed to equilibrium, the FeO would approach zero and desulphurisation would be substantially complete. Such a condition is never reached in the blast furnace because FeO is being replaced continuously in the form of incompletely-reduced iron ore and as a result of oxidation in the combustion zone.

To determine the effect of FeO on desulphurisation, a study of equilibrium in reaction (1) was started. This necessitated the elimination of graphite as a refractory material for holding slag and metal. After unsuccessful trials with refractory mixtures, a furnace was constructed to utilise a rotating liquid crucible composed of one of the reacting substances. This type of furnace has been employed by other investigators, but as each individual application must meet different requirements, a number of changes was necessary before satisfactory operation could be obtained.

Preliminary values have been obtained for equilibrium at 1,600 deg. C., using purified FeS as the liquid crucible to hold the standard calcium-aluminium-silicate slag. Values will be obtained for other temperatures and slag compositions. Before the equilibrium constants can be evaluated, however, it will be necessary to know the amount of molecular FeS present in the slag at different temperatures or prove that it is substantially insoluble in the slag. At the present time no method is available for determining the amount of FeS or MnS that may exist in blast-furnace slags while desulphurisation is taking place.

A study of the absorption spectra of slags containing iron and sulphur has been started and may develop into a method for determining FeS in slags. When either FeS or FeO was added to a slag containing CaS a highly-coloured brown to black slag resulted. Similarly coloured slags were obtained when the standard calcium-aluminium-silicate slag was allowed to react with molten ferrous sulphide. It is thought that the intensity of the colour is proportional to the amount of ferrous sulphide present.

Seventh International Management Congress

The Seventh International Management Congress will take place in Washington from September 19 to 23, 1938, under the auspices of the International Committee of Scientific Management, of which Viscount Leverhulme is President. It is expected that over 2,000 persons will be present, representing some 30 countries. The Congress is being organised by the National Management Council of the U.S.A., and is receiving strong support from American industry. Further information about the Congress can be obtained from Mr. U. Baliol Scott, Secretary, The British Management Council, Room 68, Armour House, St. Martins-le-Grand, London, E.C.1.

Some Aspects of Heavy Castings*

By E. LONGDEN (Foundry and Patternshop Manager, Craven Bros. (Manchester), Limited)

PART I

There are so many phases in the course of producing large and heavy castings that it would be impossible to touch more than briefly all aspects. To skim over the surface of casting production in an endeavour to associate all aspects would not be worth while. During the preparation of the material for this lecture, two important subjects—contraction and distortion in large castings, and suitable metal for large castings—began to dominate the author's attention over other subjects, and he was compelled to deal with these two aspects more fully than he had at first intended. One good reason for these preferences was that a portion of the data of both subjects was already compiled, and a second reason was that he felt it would be interesting to include the new investigations carried out, particularly in respect to contraction in large grey iron castings.

FIG. 1.—PORTABLE MOULD DRIER BEING APPLIED TO A 22-TON BEDPLATE MOULD.

FIG. 2.—17-TON CAUSTIC POT.

It is intended to deal with the following subjects in the order stated:—(1) Equipment and tackle for heavy casting production; (2) moulding a 17-ton caustic pot; (3) moulding a 20-ton hydraulic cylinder; (4) moulding a 21-ton 51-in. gun tube boring machine spindle; (5) moulding a 32-ton 94-in. lathe headstock; (6) moulding a 50-ton hammer anvil block; (7) design and its influence on contraction and distortion; and (8) suitable metal for large castings.

The equipment and tackle for producing heavy castings is not elaborate, but should be substantial and consist of:—(1) Adequate crane capacity, chains, slings and facilities; (2) sound dry floor and moulding pits; (3) binding-down tackle and holding-down weights; (4) substantial moulding boxes and general loose tackle; (5) melting furnaces and ladles; (6) sand mixing machinery; (7) mould and core drying appliances, fixed and portable; and (8) suitable sand mixtures and refractories.

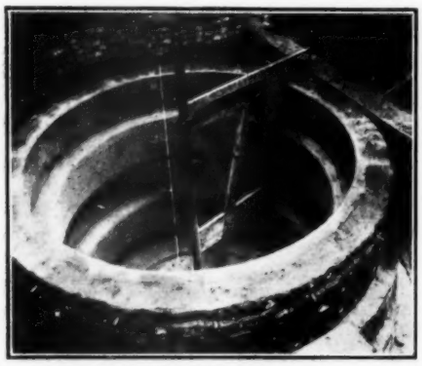

FIG. 4.—SPINDLE LOAM MOULD MADE WITH LIMITED TACKLE.

(1) Adequate crane capacity can be defined as "the provision of the necessary number of cranes, reliable in power, speed and performance for the scope of the work." The lifting power of at least one crane in each bay should be equal to a lift of 100 per cent. above the heaviest casting to be produced. It must be remembered that most castings contain cores, the weight of which may equal the weight of the casting. Again, there is often a hidden hold on a casting moulded in the foundry floor, such as by sand and irons attached to the protuberances on the underside, and also from grids often located under moulds, for bolting down cores. Speed and reliability are very important during the pouring of a casting. What other calling or trade on land possesses the hazards surrounding the critical moment of pouring a large casting? If the crane ceases to function for 30 seconds, a casting which has taken weeks and sometimes months to make may be lost—just in a flash. Such a hazard, along with the many other risks connected with the production of large, expensive castings, puts an unusual strain on the mental and physical energy

FIG. 3.—PROBABLY THE LARGEST CAST-IRON SPINDLE CASTING SO FAR MADE.

of supervision and the job charge moulder at the moment a large mould is poured. Substantial chains and slings are needed, stamped to lift 50 per cent. only of the ultimate lifting capacity of the chains.

(2) The need for dry floors, suitable moulding pits; (3) binding-down tackle and holding-down weights; and (4) moulding boxes and general tackle will be obvious during the description of the moulding of large castings.

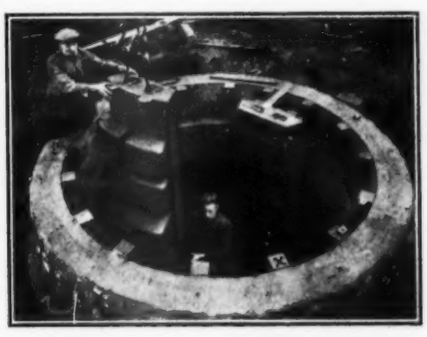

FIG. 5.—THE CORING-UP OF THE SPINDLE MOULD. NOTE THE BLOCK CORES MARKED X ARRANGED AROUND THE 12-IN. HEADER TO FACILITATE BREAKING AFTER THE HEAD HAS BEEN MACHINED OFF.

(5) Cupolas for melting cast iron should be of such a capacity to enable the melting of sufficient metal in a given time, without losing the necessary superheat needed to produce sound castings.

* A Paper read before the Scottish Branch of the Institute of British Foundrymen, Mr. E. J. Ross presiding.

(6) Sand mixing machinery needs little comment, beyond the statement that the ability of the machinery to produce a correctly milled and aerated sand in ample quantities is necessary.

(7) The vast majority of heavy castings are made in dried moulds. Many classes of casting moulds can be made in standard boxes and transported to stoves, but the largest of castings are produced in the foundry floor, and must therefore be dried *in situ*. The provision of good, controllable portable mould driers with forced-air supply in preference to the obsolete open fires needs to be emphasised. It is the author's standard practice to dry both sand and loam by hot gas producing machines generally. A large bedplate mould 31 ft. long is being dried.

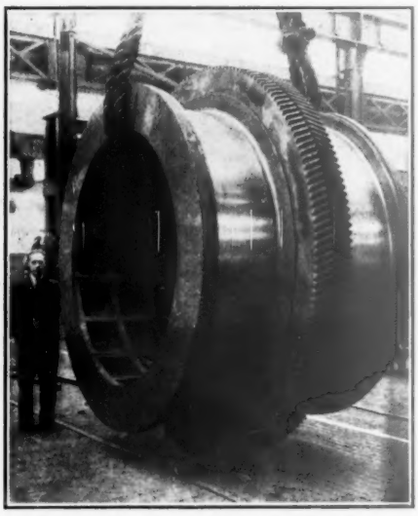

FIG. 6.—FINISHED SPINDLE CASTING, WITH STEEL GEARING ATTACHED. A CLOSE-GRAINED SURFACE IS ESSENTIAL.

(8) The provision of suitable facing sands and mould refractories is very important if castings of soundness and pleasing appearance are to be produced. Sands selected for heavy castings need to hold a preponderance of medium grains and a strong refractory bond, and must carry a rather low percentage of the alkalies magnesia and lime.

Costs of Special and General Moulding Tackle

The description of the moulding of the caustic pot and the spindle casting in loam and the hydraulic cylinder in sand will be used principally to draw attention to the relationship between special and general tackle and the ultimate costs of castings.

The production of castings of the pot-shaped design such as the 17-ton caustic pot, shown in Fig. 2, is obviously best carried out by the strickled loam moulding method. The shape lends convenience to the preservation of most of the outside building for subsequent castings. It must be remembered that it is not unusual to order more than one casting off such a job, but an even more important reason for producing castings in loam is the greater degree of soundness obtained. A strong hard mould acts as a mild densener to the metal and also is more resistant to the solidification shell expansion which is common to grey cast irons. It is also more easily possible to produce clean castings free from included sand due to erosion and the breaking away of the mould face. Castings will be cleaner in general outline, and approximate more closely to the required section and weight, than can be obtained by the rammed sand method.

The author has produced the pots moulded dome uppermost and also the reverse way, that is, the dome in the bottom of the mould. The vast majority of pots, however, are moulded dome downwards. The points in favour of producing the castings dome uppermost are that when moulded dome down the castings are drop-gated with the runners equally spaced around the rim. If moulded the reverse way, the gates enter at a tangent at the bottom of the rim, and when the metal passes the second joint about two thirds the distance up the side of the pot, a second set of spray gates encircling the pot are allowed to function.

The production of cast-iron tackle such as lifting, strengthening and top plates is a very heavy cost if the moulds are transferred to the stove for drying. The weight of cast-iron tackle for such a job can exceed 40 tons. Taking a long view, this tackle may not be of too great account if large numbers of castings are required. Yet what of the expense of transferring and loading large moulds in stoves and ramming around in the foundry floor? Moulds are cheapest dried in the foundry floor, as tackle can, thereby, be reduced 75 per cent.

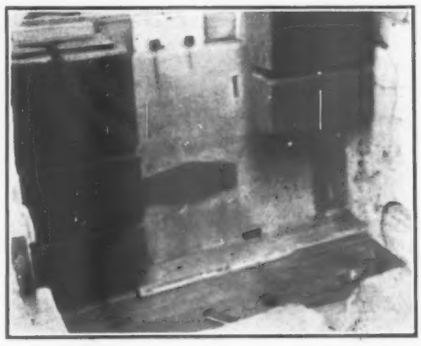

FIG. 9.—THE START OF THE CORE ASSEMBLY.

21-Ton Gun Tube Boring Machine Spindle

The remarks in criticism of stove-drying apply more strongly to castings of the design shown in Fig. 3, *et seq.*, which indicate that it is not possible to preserve any part of the brick building. Moreover, since such large spindle castings are rarely produced—and it is believed that this is the *largest cast-iron spindle yet made*—the usefulness of tackle for subsequent castings is not present.

FIG. 7.—THE BOTTOM OF A MOULD FOR A 32-TON LATHE HEADSTOCK CASTING.

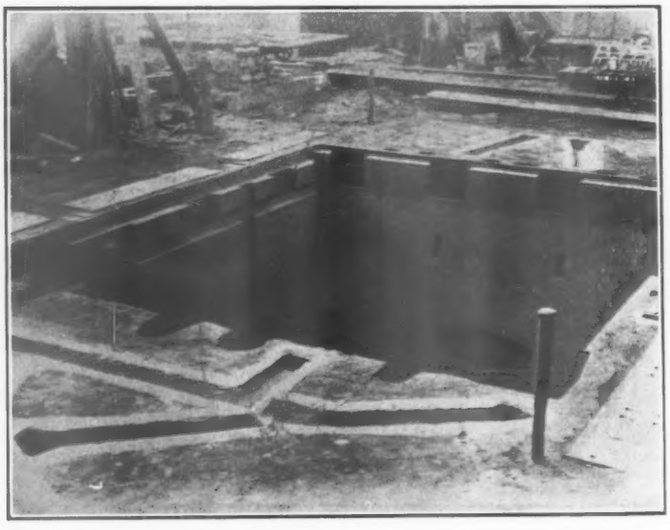

FIG. 8.—UPPER PORTION OF THE MOULD SHOWING INGATE AND JOINT GATE CONNECTIONS.

Figs. 4 and 5 show that the casting was moulded in the foundry floor, the outside being strickled without employing any plates except for the overhang on the sides of the mould; these plates were 1 in. in thickness and weighed

moulds in the foundry floor. The relationship of such a practice to costs will be enlarged upon during the description of moulding large castings.

Fig. 1 illustrates the employment of a portable mould drying machine designed by the author and developed to overcome difficulties experienced sullage and sand from the metal and mould will be deposited on the outside of the pot (instead of on the underside of the dome and inside the pot, when poured dome down), thus prolonging the life of the pot. On the other hand, production is cheaper made in the orthodox way, that is, dome downwards.

1 ton. The inside was conveniently formed by segment cores, the irons of which weighed about 2 tons. The top portion of the casting was covered by a plate of general universal design and in constant use for other castings. Fig. 6 shows the finished machined spindle with steel gear attached. Generally, the sections of the metal average $2\frac{3}{4}$ in. in the black casting, with more massive sections about the flanges. The total weight of the new tackle for the 21-ton casting was 3 tons. If the ultimate cost of the tackle after the metal recovery be £4 per ton, then £12 must be added to the cost of moulding the spindle.

If the casting had been strickle loam moulded inside and outside with various joints and carried to a stove for drying, the new tackle would have exceeded the weight of the casting required. The cost of 22 tons of tackle at a final cost after metal recovery of a minimum of £4 per ton would be £88. The cost of the tackle alone would have exceeded the whole labour costs of producing the casting by about 800 per cent.

This matter of tackle costs was brought clearly to the notice of one of the foundry staff when he desired to make the usual loam moulding plates for this job. After reminding him that the portable mould drying facilities must be applied to the production of the spindle in the floor and consequent elimination of 90 per cent. of the usual tackle, the foundry produced the spindle in the manner stated.

Quite a number of foundries live in a fool's paradise regarding the cost of tackle. Such material is often booked to an overhead charge account as semi-permanent, or relegated to a general contingency account. One can see the foundry and foundry yards of reputable companies encumbered with tackle which has only the remotest chance of being re-used. As time passes, the snowball effect of the accumulated tackle with its book value plays a stealthy part in raising overhead charges. Any foundry tackle required for a special casting which is not likely to be of repeated or general use should be allocated to the cost of that particular casting, with a deduction equal to the average overhead general tackle account.

The section moulding boxes for producing heavy hydraulic cylinders are machined on the joints, pin-jig drilled, and therefore interchangeable. Short or long castings within the scope of the boxes can readily be made. This is a case where the provision of an elastic and adaptable set of boxes, although expensive to produce, will be of enormous advantage in the economical production of a large range of castings. The boxes are of a permanent nature, more so than any other class of moulding box.

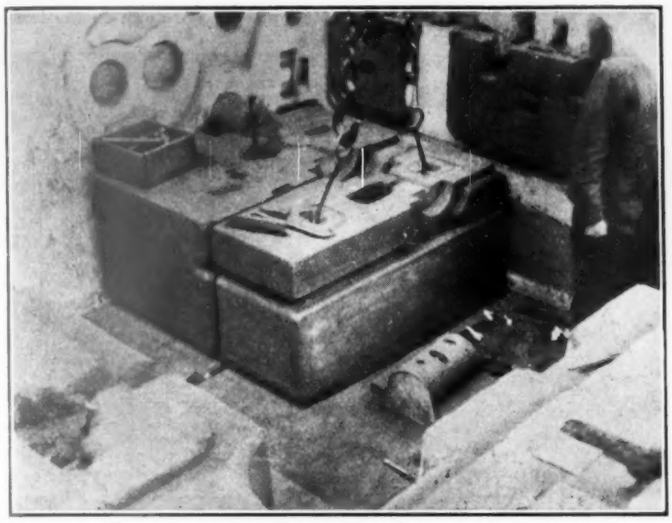

FIG. 10.—LOCATING OF THE CORES FORMING THE GEAR-BOX SECTION. NOTE THE BOLT FOR ANCHORING THE CORE.

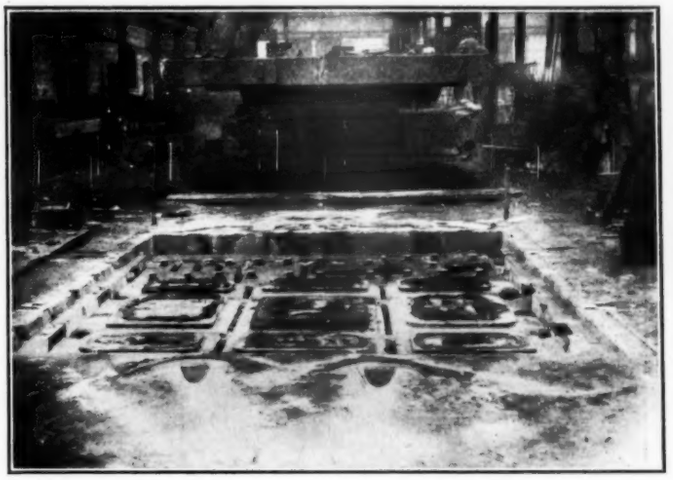

FIG. 11.—THE CORED-UP MOULD CARRYING THE CLAY THICKNESS-TEST DEVICES. THE TOP PART MOULD IS SEEN IN THE BACKGROUND.

A Large Headstock Casting

The 32-ton lathe headstock casting shown in Fig. 7, *et seq*, forms with two other castings a composite headstock weighing 50 tons for a 94-in. lathe. As a headstock casting, the 32-ton casting can be considered as of record size. The design of a headstock is somewhat necessarily complicated and constitutes a very interesting moulding job. The series of photographs, Figs. 7 to 13, shows the various stages of manufacture.

Fig. 7 shows an early stage of the job, that is, the bottom of the mould. It illustrates the bolting-down and core-setting arrangements. The cores are bolted down through holes leading to grids placed beneath the bottom of the mould. The six white-ringed holes in the foreground are locating points or seatings for the cores. Cast-iron studs integral with the core iron pass through the section of the metal on the underside of the core and sit in the metal seatings. The binding-down bars, six in number, are fastened to horizontal bars below the bottom of the mould.

Fig. 8 shows a general view of the upper mould with two ingates and the joint gate connections on each side of the mould. The long joint runner gates were necessary in order to allow two crane ladles to operate when pouring the job. A third crane and ladle functioned at the end of an auxiliary runner trough passing metal into one of the main pouring basins. Thus three ladles of 20, 15 and 5 tons capacity were necessary to

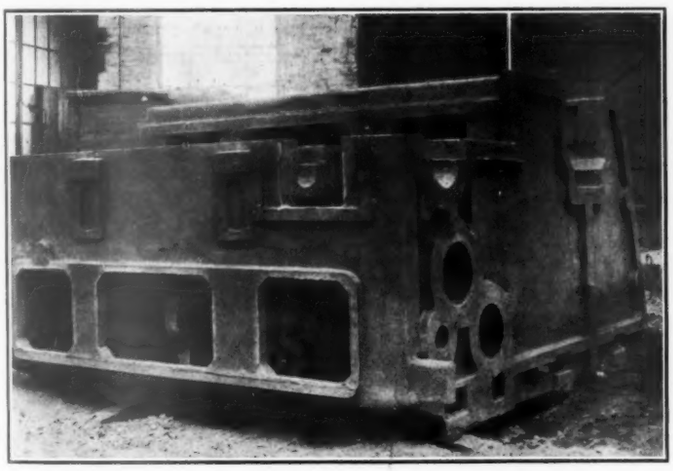

FIG. 12.—94-IN. 32-TON HEADSTOCK CASTING, LOOKING INTO THE GEAR-BOX AREA.

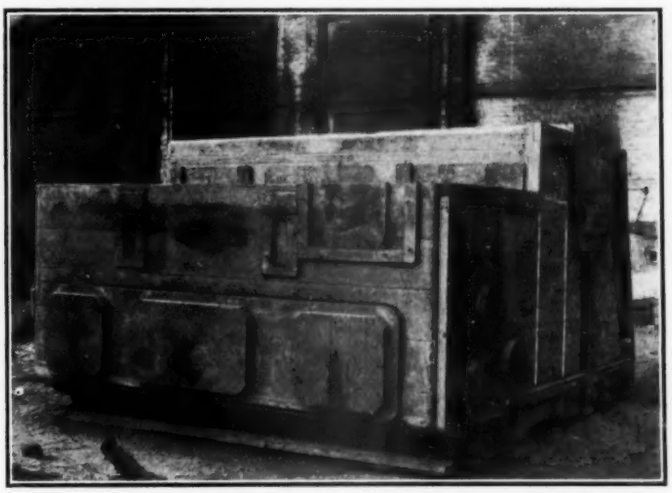

FIG. 13.—THE PATTERN FOR THE CASTING SHOWN IN FIG. 12.

provide 37 tons of metal safely to pour the 32-ton casting.

Fig. 9 shows one of the three large wedge-shaped cores being lowered into the mould. The only vent for these cores lies on the upper face of the core. The cast-iron studs on the under side of the core are for the purpose of maintaining the cores both sideways and upwards. They locate in metal seatings on the bottom side of the mould. Chaplet studs are arranged on the outside upper part of the core, and are shown above the ingate and between two cores. On the left a core is shown finally located.

A 50-Ton Anvil Block

The problems connected with the production of a large mass of metal, such as a 50-ton hammer anvil block, which is roughly the size of a 6-ft. 6-in. cube, through which run several small slender cores, are not too obvious to the man outside the foundry. Solid masses of metal, however, present problems which need careful consideration above the ordinary. Figs. 14 and 15 show models of the pattern for the 50-ton hammer block and Fig. 17 the casting.

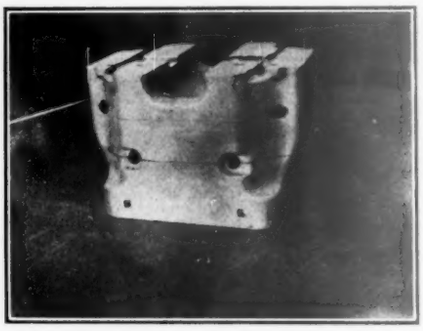

FIG. 14.—MODEL OF ANVIL BLOCK.

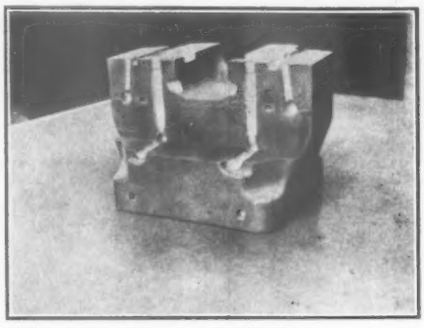

FIG. 15.—THE ANVIL BLOCK MODEL CUT AWAY TO REVEAL CORE PASSAGES.

The problems to be faced are the production of a solid casting free from cavities; making of slender cores which will withstand the prolonged temperature, pressure and mass of metal, and compounding of a refractory sand mixture especially for the top side of the mould.

Fig. 15 illustrates the model of a hammer block cut away to show the slender core passages, and Fig. 16 gives through a model mould a representative sectional and plan view of the inside of the mould with the cores located.

The problem of the cores is solved by a mixture of refractory as follows:—50 per cent. mineral blacking, 30 per cent. high silica sand (not sea sand), and 20 per cent. of good-quality ganister, thoroughly milled for 15 minutes, starting from dry materials to which is added gradually water up to 7 per cent. The cores are also enclosed in a ¼ in. casing of mild steel.

The problem of supplying metal to replace fluid shrinkage is met by the provision of a 12 in. diameter feeder gate located in the centre of the casting, as indicated in the model mould, Fig. 16. The feeder gate is kept open for from 6 to 7 hours by hand feeding. Such a long feeding process is made possible by the provision of a number of dried-sand feeder gate boxes, so that when the metal solidifies progressively from the sides inwards, the whole of the feeder metal and feeder bush is lifted completely away by the crane and a new feeder gate box substituted. Hot metal is then poured into the feeder from a ladle. The supply of feeding metal is met by the cupola or cupolas normally in blast, and finally by metal from a cupolette.

The casting is poured through four 6 in. by 2½ in. ingates located two at each side, as shown in photograph Fig. 17. The wooden gate sticks are shown placed in position against the casting. The cores are secured from floating by passing a bolt through the cores to grids located under the bed of the mould in the case of the cores standing vertical, and through to grids located on the sides where the core runs also at right angles, that is, horizontally.

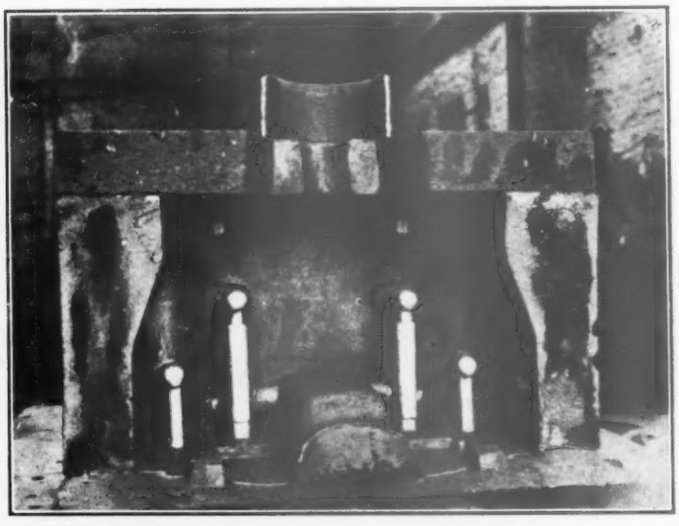

FIG. 16.—SECTIONAL ELEVATION OF THE ANVIL BLOCK MOULD.

The top of the mould is subject to the excessive glare of the rising metal. Normal sand mixtures will not respond, since the radiation from the metal will quickly pull in the top face of the mould. A refractory of the following composition is suitable:—Mineral blacking, 20 per cent.; best quality ganister, 30 per cent.; and high silica sand, 50 per cent. The materials must be mixed as indicated for the slender cores, but in the form of a stiff loam by adding sufficient water. A 1 in. face of the refractory is placed on the top of the pattern and gaggers are located at intervals of 3 in. When the top is being finished, the whole surface is sprigged with 4 in. nails at intervals of 1 in.

The supply of metal is a question of capacity equal to producing about 55 tons of fluid iron. The metal is allowed to cool down to the lowest temperature consistent with safe running, so that the feeding period will be shortened and sand fusion minimised. Test bars are usually asked for, and bars are seen located on the casting in Fig. 17. Of course, it is ridiculous to attempt to produce test bars attached to such a class of casting. In this case, whilst attaching bars as requested, it was decided to ask the inspector to see the casting poured, and also see two 2.2-in. dia. test bars poured from the same metal. The test bars cast separately fulfilled all requirements, but the bars attached to the cast ing were hopeless, as would be expected.

A 1 in. test bar poured in the class of metal prescribed for the block would turn out mottled, even if a clean run bar was secured.

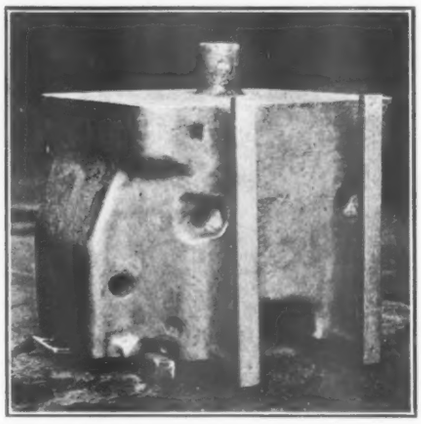

FIG. 17.—THE FINISHED ANVIL BLOCK CASTING. NOTE THE TEST-BAR AT THE BOTTOM LEFT.

Lead in Cast Nickel-Silvers

Mr. F. Hudson is of opinion that the following paragraph makes a useful addendum to his article on nickel silvers, published in the JOURNAL last week. It refers to lead additions in respect to welding, and reads:—

For ornamental castings which have to be welded to fabricated sections, some trouble has in the past been experienced through the presence of lead which tends to cause cracking if any stress be present in the articles being welded. The prevention of stresses during welding should be a function of welding technique and not a factor primarily associated with the composition of the metal employed. However, until the art of welding non-ferrous metals is more fully developed the elimination of lead does assist the production of sound welds. If lead-containing nickel-silvers are employed, it is advisable to consider alternative methods of joining such as the bolting or screwing of sections together.

ON FEBRUARY 21, George Cohen, Sons & Company, Limited, opened a new showroom in the centre of Birmingham, at 181, Corporation Street, in the same building as their offices at No. 191. A selection of the Raskin high-precision power presses, for which George Cohen are sole sales concessionaires for the British Empire (excluding the Union of South Africa), will be displayed.

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Toughness of Cast Irons from Transverse Strain Curves

At the February meeting of the Birmingham Branch of the Institute of British Foundrymen, MR. G. L. HARBACH presented his Paper entitled "Toughness of Cast Irons from Transverse Strain Curves." This was originally given to the Association Technique de Fonderie de France as an Exchange Paper. It was printed in our issue of August 20, 1936. In it the author showed that deflection in a transverse test for cast iron could be resolved into two components—plastic deflection and elastic deflection. The resolution of these two components was achieved by loading and unloading the bar at definite increments of stress up to the breaking point. On taking the load off the bar, a certain amount of set (plastic deflection) remained in the bar which, on subtraction from the total deflection obtained on loading, gave the elastic deflection for that particular stress. Mr. Harbach found that the characteristics of the plastic deflection curve so obtained bore a definite relation to the toughness of the material. A wide variety of irons were tested, and it was found that a high degree of plasticity towards the breaking load was a characteristic of tough irons as indicated by the repeated impact and single-blow impact tests.

Vote of Thanks

MR. J. G. PEARCE, in proposing a vote of thanks to the lecturer, said he was glad Mr. Harbach had given his Paper in Birmingham, because when originally presented it did not appear to be discussed. He welcomed the opportunity of expressing his appreciation of the Paper, particularly as Mr. Harbach had been able to confirm with so many samples the original results he gave on four irons chosen to represent the range from brittle to tough, and that brittle irons had low, and tough irons high set, giving greater resistance to shock.

MR. P. A. RUSSELL expressed his sincere pleasure in seconding the vote of thanks. Mr. Harbach had been of great assistance to the Institute in their work on specifications. He (Mr. Russell) had come to regard Mr. Harbach as a specialist on deflection. Interest had been shown in this work when considering high-duty irons, and some people wondered whether the ironfoundry was not getting the extra strength at the expense of other properties. He would like to know if the repeated loading necessary to obtain the set-deflection curve was in any way detrimental to the ultimate breaking strength. A further point he would like to raise was that the majority of castings in service were only stressed to a small percentage of the maximum breaking load, and according to the author's curves there was no appreciable plastic set until near the breaking load. Was the plastic component, then, so important as one was led to believe?

In replying, MR. HARBACH agreed that high strength was in some cases associated with brittleness, but he believed that, provided the iron gave a good plastic curve near the breaking load, it would not lack toughness. However, one should know for certain when large-scale tests had been carried out on this high-duty iron.

With regard to the repeated loading affecting the breaking load, he was fairly certain that it would not be detrimental. Whilst no one would expect two bars of cast iron to be identical, he had tested a batch of six and had not found a difference of more than ± 5 per cent. between normally broken bars and repeatedly loaded bars.

With regard to the question of the importance of plastic deflection, he was convinced that it was a vital factor governing toughness, and even though the working stress was below the elastic limit, an iron which was plastic at the breaking point would impart this benefit to the iron at lower stresses.

Balancing Mechanical Properties

MR. PEARCE said that the question now arose as to what caused the set in cast iron. There was little doubt, he said, that it was due in part to the graphite cavities and in part to the matrix. The part resulting from the cavities was not plastic distortion in a true sense, but a kind of slip or readjustment at the cavities. This could be shown in various ways. If one tested two irons of the same composition, but different graphite sizes, the small flaked graphite iron would have the smaller set for the same load. This was one of the difficulties with strong irons. Unless the matrix could be made tougher, *i.e.*, plasticity due to coarse graphite transferred to the matrix when graphite was reduced, then the irons would become too brittle. However, this could be done.

Under certain conditions, an iron considered soft might have a low set if high in phosphorus. The phosphorus created a framework which dominated the structure and made it unyielding, however soft the filling might be. Set could be obviously increased by using a soft iron having coarse graphite flakes from a heavy section, say an ingot mould, but the coarse flakes would lead to early rupture, and the yielding character of the structure could not in the test be fully utilised. Hence one must compromise. Thus, continued Mr. Pearce, the set helped to take the place of ductility, being in part a true ductility (matrix) and a capacity to adjust under stress at the flakes which gave a pseudo-ductility. Cold-blast irons, hematite irons and low silicon irons, all had good set. White irons were strong, but rigid without set, and would break like a carrot.

If a bar was stressed below its fracture load and then the load was released, a certain capacity to deform was removed. The set remained as a permanent deformation, and, tested again to the same load, the bar behaved elastically, but further loading caused it to behave as originally—as if it had not been previously loaded. Of course, if loaded in a fresh place, it would behave as originally in spite of the deformation in the old place. All this suggested slipping at the cavities. Mr. Pearce then showed slides of cast iron and steel bars which had been loaded and unloaded several times, and pointed out that whilst the steel bar came back nearly to its original position, several loadings were necessary in the case of the cast iron before it behaved truly elastically.

This capacity to deform, said Mr. Pearce, was connected with damping capacity and made cast iron suitable for crankshafts. The commoner the iron the greater the damping, and the more like steel the less the damping. This damping was due to and depended on the graphite flakes, and they caused discontinuities which prevented the building up of fugitive stresses.

Effect of Heat-Treatment

MR. J. J. SHEEHAN said he was sorry that no reference had been made to the effect of heat-treatment on the stress/strain properties.

MR. HARBACH, in reply, said he had as yet no experience of heat-treated irons, but he hoped to carry out experiments on such material in the near future. When his present work was conducted two years ago, he wished to confine himself to a study of the properties of straight irons such as might be used in any works.

MR. PEARCE suggested that one might predict to some extent the effect of heat-treatment, although one could not gauge the exact extent of the change in properties. He suggested that, provided the heat-treatment was for stress removal only, then no effect would be found in the stress/strain curves. If the heat-treatment was employed for machinability by decomposition of the pearlite, then there would be an increase in the plastic set and a lower elastic deflection. Heat-treatment for production of fine graphite would increase the elastic deflection and lower the plastic deflection.

MR. A. TIPPER asked the lecturer which was the more important, the plastic or elastic deflection. From Mr. Pearce's slide, it appeared that the plastic component was gradually eliminated by repeated loading and unloading. Thus it would seem that an iron would eventually lose its toughness.

MR. PEARCE pointed out that the plastic component was removed only at the particular load under consideration, and the irons so treated would be quite plastic at greater loads.

MR. HARBACH said that whilst repeated loading up to a particular load removed the plastic deflection, it did so only up to that load. There still remained a great portion up to the breaking point.

Intervening, MR. TIPPER asked if that fact would not make the iron brittle.

The LECTURER pointed out that it was the extent of the plastic component near the breaking stress that determined toughness. He illustrated this by showing that a quenched steel wire was elastic up to a point, but, possessing no plasticity at high loading, it was easily snapped by the fingers. On the other hand, a toughened wire was not easily broken, owing to the high proportion of plasticity.

Rate of Loading

MR. PEARSON said that it was well known that pitch broke like a brittle material if suddenly loaded, whereas it would bend if slowly loaded, and he wondered if the rate of applying the load had any effect on the stress/strain curves for cast iron.

MR. HARBACH replied that the fact that stress/strain curves were not affected by rate of loading was borne out by the repeated impact results, as such results put the irons in the same order of toughness as did the transverse strain curves. It should be remembered also that pitch was in one sense a fluid and would flow very slowly through a funnel.

MR. A. E. LESTER said that in the case of malleable iron he found that whereas a sharp blow would break it off short, a large number of soft blows would cause it to bend.

MR. HARBACH said he had no experience of malleable cast iron, and MR. PEARCE suggested that, in the sudden blow, the stress was concentrated on one spot whereas repeated blows were spread over a larger area.

Future of Synthetic Materials

PROF. C. E. INGLIS, discussing a Paper by Dr. H. J. Gough and Mr. W. A. Wood on "The Deformation and Fracture of Metals," at the Institution of Civil Engineers on February 15, said he believed there were indications that we were now nearing the end of the iron and steel age, because already synthetic materials of a non-crystalline character could be produced, which on a comparison on the basis of weight were much stronger than the toughest steel. There were many natural products also which could achieve the same result. To take one case, a spider's filament had a tensile strength of about 70 tons per sq. in., but, in so far as it was only one-eighth the weight of steel, on a weight comparison it compared with a steel which had an ultimate tensile strength of 560 tons per sq. in. To take one synthetic material only, glass, if it were not for a superficial layer which was weak in tension, would certainly have a resistance of the order of 500 tons per sq. in., and, even now, by putting the outside of the glass into an initial state of compression, so that that weakness which the superficial layer possessed was neutralised, glass toughened in that way was comparable in strength with a high-grade steel. He certainly visualised that at a date not many generations ahead steel might cease to be pre-eminent as a structural material.

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Bentonite not only saves a considerable portion of sand costs, but also takes up less storage space, saves inward and outward handling of new and old sand respectively, and dumping costs. It avoids many casting losses and the necessity of sacrificing efficient permeability for higher bond strength. In many instances both are essential. With Bentonite either or both can be controlled at will.

Bentonite develops its maximum bond strength at 3 per cent. moisture in the sand, and in no case is it necessary to use a higher moisture content.

The amount of Bentonite required to give the necessary amount of bond naturally varies considerably, depending upon the amount of bond already in the sand being used, but in no case is more than 4 per cent. required, and that only in silica sands for steel castings in the first mix. When the sand is regenerated the Bentonite can be reduced to 2 per cent. and often less. Several steel foundries are, and have been for some time, using as little as ½ per cent.

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The Week's News in Brief

Trade Talk

THE ANNUAL CONFERENCE of the Institute of British Foundrymen will be held at Bradford, from Tuesday, June 14, to Friday, June 17, inclusive.

THE GLASGOW OFFICE of David Brown & Sons (Hudd.), Limited, will be transferred to 29, St. Vincent Place, Glasgow, C.1, on Monday next.

M. COCKBURN & COMPANY, LIMITED, Gowan Bank Ironworks, Falkirk, have been granted permission to erect an enamel-preparing department at a cost of £5,000.

BRITAIN'S ONLY GOLD MINE, at Brunant, Pumpsaint, Lampeter, Wales, which belongs to British Goldfields (No. 1), Limited, has just installed four additional Blackstone Deisel engines.

SMITH & COMPANY (SOUTH SHIELDS), LIMITED, have completed at their Holborn Foundry, South Shields, another 19-ton cast-iron propeller similar to one completed some weeks ago for a foreign vessel.

AN 80-TON cast steel housing for the slabbing mill being erected at the Ebbw Vale Steelworks by Richard Thomas & Company, Limited, has been despatched from the Coatbridge works of Lamberton & Company, Limited.

THE KING AND QUEEN and the Duke of Kent, attended by Mr. Oliver Stanley and Lady Halifax, visited the B.I.F. stand of Imperial Chemical Industries at Olympia on Tuesday. They were received by Mr. Sidney Rogerson, publicity manager of I.C.I.

THREE BRITISH SUBMARINES of two different classes were launched at Barrow from the Naval Construction Works of Vickers-Armstrongs, Limited, on the same tide. They were the "T" Class "Triumph," and the "U" Class "Unity" and "Ursula."

THE DIRECTORS of Vickers, Limited, announce that the following final dividends are to be paid for the half-year ended December 31, 1937:—2½ per cent., less income tax, on the preferred 5 per cent. stock; 2½ per cent., less income tax, on the 5 per cent. preference stock; 2½ per cent., free of income tax, on the cumulative preference stock.

AN EXTENSIVE SUITE of offices has been erected in Graham's Road, Falkirk, for Allied Ironfounders, Limited. When ready for occupation the various staffs will be centralised in the new building, which is of two storeys and has an imposing frontage of 140 ft. The lower portion of the building is finished in green Swede granite, and the upper part is of synthetic stone. The main entrance, finished in black granite, has massive ribbed marble columns flanking the doorway on either side. These offices provide a floor space of 15,000 sq. ft.

THE DIRECTORS of John G. Stein & Company, Limited, entertained employees in the Falkirk Town Hall last Friday. Colonel Alan Stein, M.C., presided, and in the course of his remarks stated that the works had operated at full capacity during the past year, and would do so for at least the next 18 months. He announced that the firm would be starting the manufacture of basic refractories very shortly, having secured exclusive rights for successful American processes of manufacture. Mr. John Wilkie, foreman bricklayer, presented Colonel Stein and his co-director with an illuminated address of congratulation to the company on attaining its jubilee.

THE BUREAU OF INFORMATION ON NICKEL has produced a 16-mm. silent film entitled "Nickel Alloy Structural Steels." It indicates some of the many applications of nickel steels in the motor-vehicle, aircraft, mining, marine-engineering, and other industries. Special sequences devoted to manufacturing processes and outstanding engineering achievements have been photographed, with the close co-operation of twenty or more important firms, these sequences including subjects ranging from coal-mining practice to the engine room of the "Queen Mary." The film is primarily for the use of engineering societies, which may obtain it free on request from the Bureau at Thames House, London, S.W.1.

MR. E. A. MANN has joined the board of directors of Wm. Johnson & Sons (Leeds), Limited, of Castleton Foundry, Armley, Leeds. He entered the firm in 1891, and has spent the whole of his career in the business, passing through all the different departments.

Personal

DR. C. H. DESCH, F.R.S., has been elected an honorary member of the Deutsche Gesellschaft für Metallkunde.

DR. C. J. SMITHELLS, M.C., is to deliver a series of three Cantor Lectures before the Royal Society of Arts on "Gases and Metals." These lectures will be delivered on Mondays, February 28, March 7, and March 14, at 8 p.m., at the Royal Society of Arts, John Street, Adelphi, London, W.C.2.

MR. M. B. DONALD, M.Sc., A.R.C.S., F.I.C., lecturer in chemical engineering at University College, London, has been awarded the Moulton Medal of the Institution of Chemical Engineers, which is presented each year in commemoration of the chemical engineering work of the late Lord Moulton at the Department of Explosives Supply. The Osborne Reynolds Medal, in commemoration of Osborne Reynolds, famous physicist and engineer of the last century, has been awarded to Mr. C. S. Garland, B.Sc., A.R.C.S., F.I.C., a well-known London chemical engineer.

Wills

TOMLINSON, FREDERICK, of Altrincham, engineer and metallurgist	£22,035
JELLYMAN, A. F., proprietor of the firm of Samuel Jellyman, colliery engineers and brass and iron founders, Cannock	£1,549

Obituary

MR. STUART THORPE, the chief draftsman in the foundry department of Carron Company, Falkirk, has died at the age of 85. He was fulfilling his duties at the Carron works as recently as a fortnight ago.

MR. WALTER JAMES CAIRNS died on February 5 at his home in Wigan, at the age of 65 years. A native of Stockton-on-Tees, Mr. Cairns entered the employ of the North-Eastern Steelworks, Middlesbrough, for whom he eventually became assistant chief chemist. He remained there for 25 years, leaving in December, 1913, to take up the position of chief chemist at the Kirkless Works of the Wigan Coal & Iron Company, Limited. In 1918 he joined the International Construction Company, Limited, London, for whom he travelled extensively. During the past four years Mr. Cairns had had failing health, but his services were retained in an advisory capacity.

The Institute of Metals

The Council of the Institute of Metals has found it necessary slightly to modify the programme of the annual general meeting as originally announced. Instead of the first award of the Institute of Metals Medal being made at the morning session on March 10, the medal will be presented at the opening session, in the evening of Tuesday, March 8.

The proceedings will begin at 7 p.m., when a summary of the Report of Council and of the Treasurer's Report will be given. Afterwards the names of the new officers for 1938-39 will be announced, and an announcement made of a new scheme of co-operation with the Iron and Steel Institute. On behalf of the Council, the President (Mr. W. R. Barclay, O.B.E.) will then make the first award of the Institute of Metals Medal to Sir William H. Bragg, O.M., P.R.S., an honorary member of the Institute. This ceremony will take place at 7.30 p.m.

Offered by the Mond Nickel Company, Limited, for award by the Council, the medal—which is in platinum—is given for outstanding services to non-ferrous metallurgy, whether on the practical or scientific side, without restriction of nationality or membership of the Institute.

Following the presentation of the medal, the retiring President will induct into the chair the President-Designate, Dr. C. H. Desch, F.R.S. At 8.15 p.m. prompt, after a brief adjournment, Dr. Desch will deliver his Presidential Address on "A Chemist's View of Metallurgy." Light refreshments will be served at the conclusion of the address.

Company Reports

Blakey's Boot Protectors, Limited.—Interim dividend of 7½ per cent.

Wellworthy Piston Rings, Limited.—Half-yearly dividend on the 6 per cent. preference shares.

Delta Metal Company, Limited.—Dividend of 12½ per cent. and a bonus of 20 per cent., making 32½ per cent., tax-free.

Ewart & Son, Limited.—Cash distribution on the ordinary shares of 10 per cent. (not subject to tax) out of the realised capital profits from the sale of investments.

Tungsten Manufacturing Company, Limited.—Profit to September 30 last, £3,760; depreciation, £732; tax and N.D.C., £388; year's preference dividend to March 31, 1932; to reserve, £332.

English Electric Company, Limited.—Net profit for 1937, £436,185; brought in, £36,279; dividend on the ordinary stock of 10 per cent., £144,347; to general reserve, £200,000; carried forward, £54,287.

Waygood-Otis, Limited.—Net profit, after taxation, £136,261; brought in, £26,518; to reserve for pensions, £10,000; final dividend of 12½ per cent. on the ordinary shares, making 25 per cent. for the year, and a bonus of 20 per cent.; carried forward, £13,279.

Mather & Platt, Limited.—Net profit for 1937, after charging depreciation and making provision for doubtful debts and National Defence Contribution, £209,786; brought in, £68,972; preference dividend, £20,000; dividend on the ordinary stock of 13½ per cent., £184,094; carried forward, £74,664.

Contracts Open

Bilston, March 7.—Iron castings and cast-iron pipes, for the Borough Council. Mr. Joseph L. Arlidge, town clerk, Bilston.

Norwich, March 14.—Cast-iron gully grates and frames, for the County Council. Mr. S. H. Warren, county surveyor, Stracey Road, Norwich.

West Hartlepool, March 9.—Metal castings, for the Town Council. Mr. F. Durkin, borough engineer, Municipal Buildings, West Hartlepool.

Shotley, February 28.—Provision and laying of 430 yds. 3-in. spun-iron pipes, for the Samford Rural District Council. Mr. J. W. Good, surveyor, 5, Queen Street, Ipswich, Suffolk.

Beadnell, February 28.—Providing, laying and hydraulically testing 8,100 yds. of 4-in., and 4,200 yds. of 3-in. cast or spun iron spigot and socket water mains, etc., for the Belford Rural District Council. Taylor and Wallin, engineers, 1, Saville Place, Newcastle-upon-Tyne, 1. (Fee £5, returnable.)

Zinc Sheet Cartel

It is understood that an agreement has been reached, although not yet signed, between European zinc rollers for the establishment of an International Zinc Sheet Cartel. Quotas have been fixed for each country in all export markets, and it has also been agreed that rolling margins should be raised and brought to a standard basis, where this is possible.

Forthcoming Events

MARCH 3.

Institute of Metals (Birmingham Section):—"Non-Destructive Testing," Paper by J. P. Reed, at James Watt Memorial Institute, Birmingham, at 7 p.m.

Institute of British Foundrymen

MARCH 2.

London Branch:—"Production of Pressure-Tight Castings in Grey Iron and Its Alloys," Paper by A. E. McRae Smith, at Charing Cross Hotel, London, at 8 p.m.

MARCH 3.

Sheffield Branch:—"Steel Castings," Paper by J. Deschamps, at Royal Victoria Hotel, Sheffield, at 7.30 p.m.

MARCH 4.

Birmingham Branch:—"Shrinkage and Contraction of Cast Iron," Paper by A. A. Timmins, at James Watt Memorial Institute, Great Charles Street, Birmingham, at 7.30 p.m.

MARCH 5.

Falkirk Section:—"Patternmaking in a Light-Castings Foundry," Paper by R. R. Shaw, at Temperance Café, Lint Riggs, Falkirk, at 6 p.m.

Lancashire Branch:—"Fundamental Properties of Moulding Sands," Paper by W. J. Rees, at Engineers' Club, Manchester, at 4 p.m.

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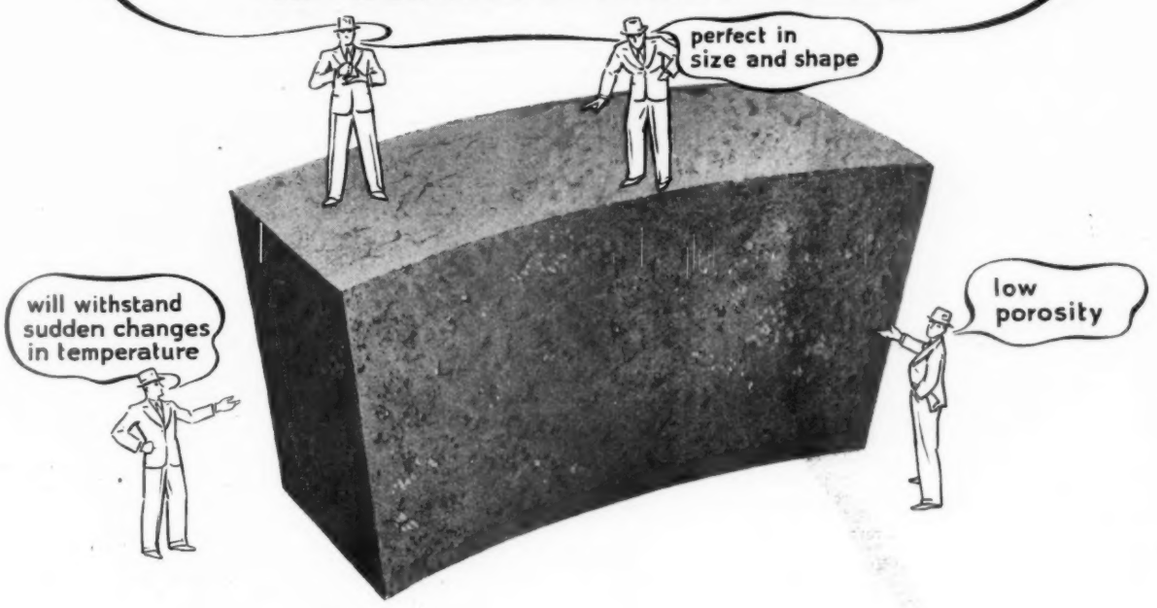

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MIDDLESBROUGH OFFICE: Halifax Bldgs., Exchange Place, Telephone: Middlesbrough 3313. Telegrams: "Genefax, Middlesbrough." (Mr. J. A. Williams).

CARDIFF OFFICE: 17, Windsor Place, Telephone: 5796. Telegrams: "Genefax, Cardiff." (Mr. F. E. Rutter).

Raw Material Markets

The extent to which British consumers had contracted with overseas producers for supplies of pig-iron before the introduction of the loyalty rebate scheme is indicated by the fact that deliveries continue to arrive in this country. When these orders were placed, consumers were experiencing considerable difficulty in obtaining home-produced iron, but the position at the present time is entirely changed, and some works are receiving supplies almost too freely to be convenient. The period fixed for the admission of foreign iron duty free expires at the end of next month, and it is suggested that reimposition of the tariff be made. The steel market remains firm, and, despite rumours to the contrary, it has been authoritatively stated that no changes in the price of British steel will be made before the end of the year.

Pig-Iron

MIDDLESBROUGH.—While the current production of Cleveland iron is scarcely sufficient to meet the demand, imports have been on a heavy scale, and consumers are now well supplied. With the threat of a reimposition of the tariff on imported iron, the reasons for the present activity to secure deliveries against orders placed abroad are obvious. Cleveland No. 3 G.M.B. iron is quoted at 109s. per ton, less 5s. rebate, for deliveries in the Middlesbrough and Falkirk districts, with 3s. extra for Clydeside. While the home inquiry for hematite is maintained, overseas buyers are displaying very little interest in new business. East Coast mixed numbers are quoted at 132s. 6d., less 5s. rebate, for delivery on the North-East Coast.

LANCASHIRE.—The poor attendance at the Exchange meetings reflects the condition of the pig-iron market in this area, and little new business is being transacted. Most consumers are taking up good deliveries, but quietness persists among textile machinists and light-castings founders. For delivery in the Manchester price zone, Derbyshire and Staffordshire No. 3 is quoted at 114s., with Northamptonshire at 112s. 6d. and Derbyshire forge iron at from 111s. to 113s., acording to the class of user. West Coast hematite is quoted at 141s., and East Coast material at 140s. 6d., subject to 5s. rebate. Scottish No. 3 is at around 141s. per ton, but supplies continue to be on the short side. Users of hematite generally are active and are calling for good tonnages.

MIDLANDS.—Business continues to be of a hand-to-mouth nature, and most consumers have no need to enter into long-term contracts, being in possession of good stocks. Motor-car makers and light-castings founders are still the quietest sections, but some other concerns are less active than they were a few months ago. It is expected that a general improvement will be witnessed during the second quarter of the year. For delivery to Birmingham and Black Country stations, Derbyshire, Lincolnshire and North Staffordshire No. 3 irons are quoted at 111s., with Northamptonshire No. 3 at 108s. 6d. per ton. Dealings in low-phosphorus iron are active, and engineering, motor and machine-tool concerns, particularly, are entering into contracts for this type of iron. The price ranges from £6 5s. to £7 7s. 6d. Business in hematite tends to decline and orders are for small tonnages for early delivery. Supplies of all grades are now available in adequate tonnages.

SCOTLAND.—The demand for hematite and basic irons continues to be heavier than for foundry iron. Stocks of foundry are fairly substantial, both at the makers' and the consumers' depôts. No. 1 foundry is quoted at 120s. 6d. and No. 3 at 118s., f.o.t. furnaces. Local steelworks are working at high pressure and are calling for full contract deliveries of hematite and basic. Hematite mixed numbers are quoted at 133s., with Scottish basic at 107s. 6d. and English and Indian at 100s., all less 5s. rebate and including delivery to steelworks.

Coke

Users of foundry coke continue to press for deliveries, but new business is not much in evidence, consumers being well covered for as long as they deem it wise to make contracts. For delivery in Birmingham and district, best Durham coke is quoted at 55s. 9d., minimum, with Welsh coke at from 55s. to 62s. 6d. per ton.

Steel

Business in the steel market remains quiet, but lately the inquiry has shown signs of expanding. It is not expected, however, that new business will increase for a few weeks, as a considerable amount of material of home and foreign origin which has been delivered against existing contracts must be first absorbed. The consumption of most descriptions of steel is at a high rate, but for the time being contracts are being worked off more quickly than they are being replaced. Large supplies of semi-finished steel are available for the consuming works. Stocks have been replenished to a great extent, and it is not expected that there will be any considerable demand for this class of steel until the second quarter of the year. The situation in the finished material department is somewhat irregular, and, while the heavy branches of the industry are operating at capacity, and still have arrears of contracts to overtake, some of the lighter sections are not so well provided with orders. The export trade remains quiet, but lately inquiry has been slightly more active.

Scrap

In the Cleveland area, good tonnages of scrap are passing into consumption, the steelworks, especially, calling for heavy supplies. Some contraction in the general demand appears to have set in in South Wales, where the steel furnaces are in a rather uncertain position. Foundries in this district, also, are inclined to be less active, and, consequently, the demand for cast-iron machinery scrap tends to decline. Steady conditions prevail in Yorkshire and the Midlands. While the steelworks in Scotland continue to take up heavy tonnages, the ironworks have good stocks and are not in the market for more than small parcels at the present time.

Metals

The political crisis in this country has come at a time when there were signs of definite improvement in the non-ferrous metal market. The reaction, however, has been less disturbing than might have been expected, and all prices close higher on the week.

Copper.—After a welcome rally in prices, the tone of this market has become subdued as a result of the political tension. The favourable January statistics and better news from the United States have given more confidence to buyers, but little business is expected to be transacted in existing circumstances. Copper production in Canada during 1937 increased to 529,773,738 lbs. from 421,027,732 lbs. in the previous year.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £39 17s. 6d. to £40; Friday, £40 10s. to £40 11s. 3d.; Monday, £40 3s. 9d. to £40 6s. 3d.; Tuesday, £41 7s. 6d. to £41 8s. 9d.; Wednesday, £42 3s. 9d. to £42 5s.

Three Months.—Thursday, £40 2s. 6d. to £40 3s. 9d.; Friday, £40 12s. 6d. to £40 13s. 9d.; Monday, £40 8s. 9d. to £40 10s.; Tuesday, £41 11s. 3d. to £41 12s. 6d.; Wednesday, £42 6s. 3d. to £42 7s. 6d.

Tin.—At a meeting of the International Tin Committee, held at The Hague on Friday, February 18, the export quota for the second quarter of the year was fixed at 55 per cent., a reduction of 15 per cent. as compared with the current level. If anything, the cut of 15 per cent. was 5 per cent. more than had been expected, although no surprise was occasioned by the decision. In some quarters it is suggested that the present statistical position does not justify any reduction of the quota. Owing to the surrender of standard tonnages, Bolivia's actual export quota in the June quarter will, it is estimated, be 45 per cent. of original standard. For the same reason, Malaya, the Netherlands East Indies and Nigeria will have quotas equivalent to approximately 62½ per cent. of the original standard tonnages.

It is understood that the question of the formation of a buffer pool was discussed at the meeting. The official *communiqué* states that proposals had been made to the Governments interested, but replies have not yet been received, so that the question will again be discussed at the next meeting of the Committee, which is to be held in Paris on April 5.

The quota decision is, on the whole, viewed favourably in Amsterdam, although it is suggested that the actual effect of the reduction on the market will only be felt towards the middle of the year. Tribute is paid to the courage of the Tin Committee in reducing the output to below the estimated consumption level and thus making an inroad into visible and invisible supplies.

Rumours to the effect that the proposed merger between the Banka Tin Mines and the Billiton Company had broken down were current in Amsterdam during the early part of the week. It is now learned in reliable quarters that these reports are unfounded. For technical reasons the scheme has been temporarily postponed, but there is no question of a withdrawal of the proposal.

Doubts as to the future of East Pool & Agar, the Cornish tin-mining concern, are contained in a report by Bewick, Moreing & Company, general managers of the East Pool & Agar company. "Taking all circumstances into consideration," the managers declare, "we are of opinion that further expenditure on development should be suspended, and that the ore now available be extracted as cheaply as possible, and after this has been done, that the pumps be withdrawn and the mine closed." The directors of East Pool & Agar see no alternative but to carry out these recommendations. The East Pool mine has been worked continuously for over 100 years.

Official quotations were as follow :—

Cash.—Thursday, £184 15s. to £185; Friday, £185 to £185 5s.; Monday, £185 5s. to £185 10s.; Tuesday, £186 15s. to £187; Wednesday, £190 5s. to £190 10s.

Three Months.—Thursday, £184 5s. to £184 10s.; Friday, £184 15s. to £185; Monday, £185 to £185 5s.; Tuesday, £186 10s. to £186 15s.; Wednesday, £190 to £190 5s.

Spelter.—Business in this market remains dull. Brassmakers are taking up fair tonnages, but the galvanising trade is still operating at below the average level for the time of the year. The American galvanising industry is operating at around 35 per cent., compared with 24 per cent. a few weeks ago and 69 per cent. at this period last year.

Daily market prices :—

Ordinary.—Thursday, £14 3s. 9d.; Friday, £14 10s.; Monday, £14 11s. 3d.; Tuesday, £14 16s. 3d.; Wednesday, £15 7s. 6d.

Lead.—This market has been under the general influence of politics during the past few days and the immediate outlook is obscure. Building plan figures for January show a rise of 2.2 per cent. on the returns for the previous month. While the result is less satisfactory than that for December, when the increase was 12.5 per cent., it is generally considered that the returns are favourable. The January figures for 146 local authorities reveal that housing plans passed in that month totalled £5,378,900, against £7,036,900 in December, while the total for all buildings was £8,583,300, against £10,102,500.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £15 8s. 9d.; Friday, £15 10s.; Monday, £15 8s. 9d.; Tuesday, £15 16s. 3d.; Wednesday, £16 2s. 6d.

Scrap.—Despite the low prices now ruling, buying is exceedingly quiet and the scrap trade generally is very dull.

Approximate selling prices for old metal :—New aluminium cuttings, £80; rolled, £64; cast, £38; foil, £88. Copper, £36 to £39; braziery, £33. Brass (clean), £23 to £24; Zinc, £7 10s. to £8. Lead, £14. Gunmetal, £38.

Applications for Trade Marks

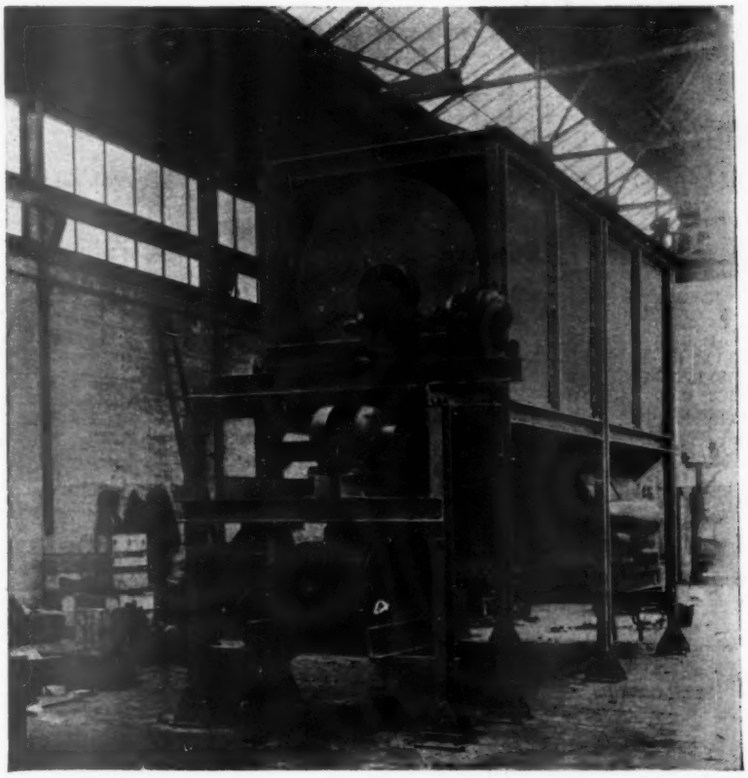
The following list of applications to register trade marks has been taken from the "Trade Marks Journal" :—

"CLOSELOY."—Metal rolls. Sir W. G. Armstrong Whitworth & Company (Ironfounders), Limited, Close Works, Coulthard's Lane, Gateshead-on-Tyne.

"DUROID."—Welding electrodes and rods. Quasi Arc Company, Limited, Thames House, Millbank, London, S.W.1.

"SILMOCROM."—Metallic alloys. Wellworthy Piston Rings, Limited, Radial Works, Stanford Road, Lymington, Hampshire.

"CLEO-AIR."—Machinery. John Macdonald & Company (Pneumatic Tools), Limited, 175, Shawbridge Street, Pollokshaws, Glasgow, S.3.



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RAW MATERIALS—PRICE LIST

(Wednesday, February 23, 1938)

COPPER

	£	s.	d.
Standard cash	42	3	9
Three months	42	6	3
Electrolytic	45	10	0
Tough	45	1	3
Best selected	45	11	3
Sheets	75	16	3
India	58	3	9
Wire bars	46	16	3
Ingot bars	46	16	3
H.C. Wire rods	50	6	3
Off. av. cash, Jan.	41	8	6¼
Do., 3 mths., Jan.	41	12	8½
Do., Sttlmnt., Jan.	41	8	8¾
Do., Electro, Jan.	45	16	0¾
Do., B.S., Jan.	45	12	6
Do., Wire bars, Jan.	46	4	4½
Solid drawn tubes			12½d.
Brazed tubes			12½d.
Wire			8d.

BRASS

Solid drawn tubes	11d.
Brazed tubes	13d.
Rods, drawn	9d.
Rods, extd. or rlld.	6½d.
Sheets to 10 w.g.	8½d.
Wire	8½d.
Rolled metal	8d.
Yellow metal rods	6¼d.

TIN

	£	s.	d.
Standard cash	190	5	0
Three months	190	0	0
English	190	5	0
Bars	192	5	0
Straits	192	5	0
Eastern	190	10	0
Banca (nom.)			—
Off. av. cash, Jan.	183	15	7½
Do., 3 mths., Jan.	184	1	8
Do., Sttlmt., Jan.	183	15	8¾

SPELTER

	£	s.	d.
Ordinary	15	7	6
Remelted	12	10	0
Hard	12	5	0
Electro, 99.9	19	5	0
English	16	0	0
India	14	5	0
Zinc dust	21	0	0
Zinc ashes	5	5	0
Off. aver., Jan.	15	1	8
Aver., spot, Jan.	14	19	10¼

LEAD

	£	s.	d.
Soft foreign, ppt.	16	2	6
Empire (nom.)	16	12	6
English	18	0	0
Off. aver., Jan.	16	3	10$\frac{17}{32}$
Aver., spot, Jan.	16	2	8½

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

	£	s.	d.	£	s.	d.
Zinc sheets, English	29	5	0 to 29	15	0	
Do., V.M. ex-whse.	29	5	0 to 29	15	0	
Rods			21	10	0	

ANTIMONY

	£	s.	d.	£	s.	d.
English	81	0	0 to 82	0	0	
Chinese, ex-whse.			69	0	0	
Crude, c.i.f.			42	0	0	

QUICKSILVER

	£	s.	d.
Quicksilver	12	17	3

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	12 10 0
45/50%	12 0 0
75%	17 0 0
Ferro-vanadium—	
35/50%	14/- lb. Va.
Ferro-molybdenum—	
70/75% carbon-free	4/9 lb. Mo.
Ferro-titanium—	
20/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£21 to £22
Ferro-tungsten—	
80/85%	6/- lb. (nom.)
Tungsten metal powder—	
98/99%	6/1½ lb. (nom.)
Ferro-chrome—	
2/4% car.	34 15 0
4/6% car.	24 5 0
6/8% car.	24 0 0
8/10% car.	24 0 0
Ferro-chrome—	
Max. 2% car.	36 0 0
Max. 1% car.	38 5 0
Max. 0.5% car.	41 0 0
70% carbon-free	10d. lb.
Nickel—99.5/100%	£180 to £185
"F" nickel shot	£165 0 0
Ferro-cobalt, 98/99%	8/6 to 8/9 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese—	
76/80% loose	£18 15 0 to 19 5 0
76/80% packed	£19 15 0 to 20 5 0
76/80% export	£22 0 0
Metallic manganese—	
94/96% carbon-free	1/3 lb.

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	3s. 6d.
Finished bars, 18% tungsten	4s. 6d.

Per lb. d/d buyers' works.

Extras— (Under revision.)

Rounds and squares, 3 in. and over	
Rounds and squares, under ½ in. to ¼ in.	
Do., under ¼ in. to $\frac{1}{16}$ in.	
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	
Do., under ½ in. × ¼ in.	
Bevels of approved sizes and sections	
Bars cut to length, 10% extra.	

SCRAP

	£	s.	d.	£	s.	d.
South Wales (West)—						
Heavy steel, best	3	8	9 to 3	11	3	
Mixed iron and steel	3	6	9 to 3	9	3	
Heavy cast iron	3	8	9 to 3	11	3	
Good machinery			3	15	0	
Cleveland—						
Heavy steel, best	3	7	0 to 3	9	6	
Steel turnings	2	13	0 to 2	15	6	
Heavy cast iron			4	2	6	
Heavy machinery	4	7	6 to 4	10	0	
Midlands—						
Short heavy steel	3	17	6 to 4	0	0	
Light cast-iron scrap			3	2	6	
Heavy wrought iron	4	0	0 to 4	5	0	
Steel turnings	2	6	3 to 2	8	9	
Scotland—						
Heavy steel, best	3	5	0 to 3	7	6	
Ordinary cast iron	4	2	6 to 4	3	6	
Cast-iron borings	2	0	6 to 2	3	0	
Wrot-iron piling	4	5	0 to 4	7	6	
Heavy machinery	4	10	0 to 4	11	3	

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	32	0	0
Brass	23	0	0
Lead (less usual draft)	14	0	0
Tea lead	11	10	0
Zinc	8	0	0
New aluminium cuttings	68	0	0
Braziery copper	30	0	0
Gunmetal	32	0	0
Hollow pewter	130	0	0
Shaped black pewter	90	0	0

PIG-IRON*

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	111/6
,, No. 3	109/-
,, No. 4	108/-
Forge No. 4	108/-
Hematite No. 1	133/-
Hematite M/Nos.	132/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	133/-
,, d/d Birm.	144/6
Malleable iron d/d Birm.	165/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	110/-
,, No. 3 fdry.	111/-
Northants forge	107/6
,, fdry. No. 3	108/6
,, fdry. No. 1	111/6
Derbyshire forge	110/-
,, fdry. No. 3	111/-
,, fdry. No. 1	114/-
Scotland—	
Foundry, No. 1, f.o.t.	120/6
,, No. 3, f.o.t.	118/-
Cleveland No. 3, Glasgow	112/-
,, ,, Falkirk	109/-
Scottish hem. M/Nos. d/d	133/-
Sheffield (d/d district)—	
Derby forge	107/6
,, fdry. No. 3	108/6
Lincs forge	107/6
,, fdry. No. 3	108/6
W.C. hematite	138/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	114/-
Staffs fdry. No. 3	114/-
Northants fdry. No. 3	112/6
Cleveland fdry. No. 3	114/-
Glengarnock, No. 3	141/-
Clyde, No. 3	141/-
Monkland, No. 3	141/-
Eglinton, No. 3	141/-
Gartsherrie, No. 3	141/-
Shotts, No. 3	141/-

(* Prices of hematite and basic pig-iron, and of foundry and forge iron with a phosphoric content of not less than 0.75 per cent., are subject to a rebate of 5s. per ton under certain conditions.)

FINISHED IRON AND STEEL

Usual district deliveries.

[A rebate of 15/- per ton for steel sections, plates and joists is obtainable in the home trade under certain conditions.]

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	13	5	0 to 13	15	0	
Nut and bolt iron	11	12	6 to 12	2	6	
Hoops			14	2	6	
Marked bars (Staffs) f.o.t.			15	15	0	
Gas strip			14	2	6	
Bolts and nuts, ¾ in. × 4 in.			17	10	0 and up	
Steel—						
Plates, ship, etc.	11	8	0 to 11	10	6	
Boiler plts.	11	18	0 to 12	0	6	
Chequer plts.			13	0	6	
Angles			11	0	6	
Tees			12	0	6	
Joists			11	0	6	
Rounds and squares, 3 in. to 5½ in.			12	0	6	
Rounds under 3 in. to ⅜ in. (untested)			11	9	0	
Flats—8 in. wide and over			11	5	6	
,, under 8 in. and over 5 in.			11	10	6	
Rails, heavy			10	2	6	
Fishplates			14	2	6	
Hoops (Staffs)			12	4	0	
Black sheets, 24g. (4-t. lots)			15	15	0	
Galv. cor. shts. (,,)			18	10	0	
Galv. flat shts. (,,)			19	0	0	
Galv. fencing wire, 8g. plain			20	5	0	
Billets, soft, 100-ton lots			7	17	6	
Sheet bars			7	15	0	
Tin bars			7	15	0	

PHOSPHOR BRONZE

	Per lb. basis
Strip	10½d.
Sheet to 10 w.g.	11¼d.
Wire	12¾d.
Rods	13¼d.
Tubes	18¼d.
Castings	15d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop. £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	8d. to 1/2
Rolled—	
To 9 in. wide	1/2 to 1/8
To 12 in. wide	1/2¼ to 1/8¼
To 15 in. wide	1/2¼ to 1/8¼
To 18 in. wide	1/3 to 1/9
To 21 in. wide	1/3½ to 1/9½
To 25 in. wide	1/4 to 1/10
Ingots for spoons and forks	8d. to 1/4½
Ingots rolled to spoon size	11d. to 1/7½
Wire round—	
to 10g.	1/5½ to 2/0½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/4½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.84
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	23.50
Ferro-mang. 80%, seaboard	102.50
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	2.40
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.25
Skelp, grooved steel	2.10
Steel hoops	2.40
Sheets, black, No. 24	3.15
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb. box	$5.35

COKE (at ovens)

Welsh foundry	42/6
,, furnace	37/6
Durham foundry	39/6
,, furnace	32/6
Scottish foundry	42/6
,, furnace	40/-

TINPLATES

f.o.b. British Channel ports.

I.C. cokes	20×14	per box	22/6
,,	28×20	,,	45/-
,,	20×10	,,	34/6
,,	18¾×14	,,	24/9
C.W.	20×14	,,	18/- to 18/6
,,	28×20	,,	36/- to 37/-
,,	20×10	,,	29/6 to 30/-
,,	18¾×14	,,	21/- to 21/6

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.	£	s.	d.
Pig-iron	£12	0	0 to £13	0	0	
Bars-hammered, basis	£20	0	0 to £22	0	0	
Bars and nail-rods, rolled, basis	£19	0	0 to £20	0	0	
Blooms	£18	0	0 to £19	0	0	
Keg steel	£30	0	0 to £35	0	0	
Faggot steel	£20	0	0 to £25	0	0	
Bars and rods dead soft st'l	£19	0	0 to £20	0	0	

All per English ton, f.o.b. Gothenburg
[Subject to an exchange basis of Kr 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£ s. d.	
Feb.	17 ..	39 17 6 inc.	13/9
,,	18 ..	40 10 0 ,,	12/6
,,	21 ..	40 3 9 dec.	6/3
,,	22 ..	41 7 6 inc.	23/9
,,	23 ..	42 3 9 ,,	16/3

Electrolytic Copper

		£ s. d.	
Feb.	17 ..	43 10 0 No	change
,,	18 ..	44 5 0 inc.	15/-
,,	21 ..	44 0 0 dec.	5/-
,,	22 ..	45 5 0 inc.	25 -
,,	23 ..	45 10 0 ,,	5/-

Standard Tin (cash)

		£ s. d.		
Feb.	17 ..	184 15 0	inc.	10/-
,,	18 ..	185 0 0	,,	5/-
,,	21 ..	185 5 0	,,	5/-
,,	22 ..	186 15 0	,,	30/-
,,	23 ..	190 5 0	,,	70/-

Tin (English ingots)

		£ s. d.		
Feb.	17 ..	184 15 0	inc.	10/-
,,	18 ..	185 0 0	,,	5/-
,,	21 ..	185 5 0	,,	5/-
,,	22 ..	186 15 0	,,	30/-
,,	23 ..	190 5 0	,,	70/-

Spelter (ordinary)

		£ s. d.		
Feb.	17 ..	14 3 9	inc.	7/6
,,	18 ..	14 10 0	,,	6/3
,,	21 ..	14 11 3	,,	1/3
,,	22 ..	14 16 3	,,	5/-
,,	23 ..	15 7 6	,,	11/3

Spelter (Electro, 99.9 per cent.)

		£ s. d.		
Feb.	17 ..	18 1 3	inc.	6/3
,,	18 ..	18 8 9	,,	7/6
,,	21 ..	18 8 9	No	change
,,	22 ..	18 13 9	inc.	5/-
,,	23 ..	19 5 0	,,	11/3

Lead (soft foreign, prompt)

		£ s. d.		
Feb.	17 ..	15 8 9	inc.	8/9
,,	18 ..	15 10 0	,,	1/3
,,	21 ..	15 8 9	dec.	1/3
,,	22 ..	15 16 3	inc.	7/6
,,	23 ..	16 2 6	,,	6/3

Lead (English)

		£ s. d.		
Feb.	17 ..	17 10 0	inc.	10/-
,,	18 ..	17 10 0	No	change
,,	21 ..	17 10 0	,,	,,
,,	22 ..	17 15 0	inc.	5/-
,,	23 ..	18 0 0	,,	5/-

AVERAGE MONTHLY PRICES OF FURNACE COKE D/D MIDDLESBROUGH

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1906	0 17 6	0 17 6	0 17 0	0 17 0	0 17 0	0 16 6	0 17 0	0 17 0	0 18 3	0 18 6	0 19 0	1 0 0	0 17 8½
1907	1 4 6	1 5 0	1 5 0	1 0 6	1 2 0	1 1 0	1 1 0	1 1 0	1 2 0	1 1 6	1 0 0	0 17 0	1 1 8½
1908	0 16 0	0 16 0	0 15 6	0 16 0	0 16 3	0 16 0	0 15 6	0 15 6	0 15 6	0 15 3	0 16 0	0 16 0	0 15 9½
1909	0 16 0	0 15 3	0 15 0	0 14 9	0 15 6	0 15 9	0 15 6	0 15 6	0 16 6	0 17 0	0 17 6	0 17 0	0 15 11½
1910	0 18 6½	0 18 6½	0 18 0	0 18 0	0 17 10½	0 17 0	0 16 1½	0 15 9½	0 15 11	0 16 0	0 15 9½	0 15 8	0 16 11
1911	0 16 0	0 15 10½	0 15 6	0 15 3	0 14 9	0 14 6	0 14 6	0 14 6	0 14 6	0 14 6	0 14 11½	0 15 0½	0 16 3½	0 15 1½
1912	0 17 3	0 17 3	0 18 6	0 18 10	0 19 0	0 19 4½	0 19 10½	1 0 9½	1 2 9	1 4 1½	1 5 8½	1 8 6	1 1 0
1913	1 5 9	1 4 11	1 5 0	1 5 0	1 4 9½	1 0 4½	0 19 5½	0 18 3	0 18 0	0 18 2½	0 18 6	0 18 6	1 1 4½
1914	0 18 2	0 17 1	0 17 0	0 17 0	0 17 4	0 17 6	0 17 6	0 18 5	0 18 4	0 17 9	0 17 6	0 18 5	0 17 8
1915	0 17 10½	0 17 9	1 0 4½	1 7 7½	1 9 4½	1 10 7½	1 9 7	1 7 3	1 5 4	1 4 9	1 9 6	1 13 0	1 6 1
1916	1 10 9	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6½
1917	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 14 3	1 15 6	1 11 2½
1918	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6
1919	1 15 6	1 15 6	1 15 6	1 15 6	2 1 6	2 1 6	2 3 9	2 10 6	2 10 6	2 10 6	2 10 6	2 10 6	2 3 5
1920	2 12 3	2 14 0	2 19 0	2 19 0	3 3 3	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 2 6
1921	3 1 0½	2 19 0	2 16 0	2 7 0	2 6 6	2 6 6	2 0 6	2 0 0	1 13 11	1 12 9	1 10 4½	1 8 3	2 3 6½
1922	1 7 0½	1 8 1½	1 9 7½	1 8 4½	1 7 11½	1 7 3	1 6 9½	1 6 10½	1 7 0½	1 10 2½	1 10 0	1 9 11½	1 8 2½
1923	1 11 3	1 14 6	2 0 1½	2 2 8½	2 4 4½	2 2 10½	2 1 0½	2 1 6	2 0 9½	1 18 9	1 18 8½	1 18 3	1 19 7½
1924	1 16 6½	1 14 9	1 11 11½	1 10 0½	1 8 1½	1 7 8½	1 7 3	1 6 3	1 6 0	1 5 0	1 5 0	1 5 0	1 9 5½
1925	1 4 10½	1 4 1½	1 13 3	1 2 4½	1 2 2½	1 1 5½	1 1 3½	1 4 9	0 18 10½	0 18 4½	0 19 6½	1 1 4½	1 2 8½
1926	1 2 1½	1 0 9	0 19 2½	0 18 6½	*	*	*	*	*	*	*	1 5 0	1 1
1927	1 5 6	1 4 9½	1 6 1½	1 3 9	1 2 6	1 0 8½	0 19 4½	0 19 0	0 18 7½	0 18 0	0 17 10½	0 17 6	1 1 1½
1928	0 17 6	0 17 10½	0 18 0½	0 17 11½	0 17 8½	0 17 6½	0 17 7½	0 17 6½	0 17 6	0 17 7½	0 17 7½	0 17 6	0 17 8
1929	0 17 7½	0 18 0	0 19 0	0 19 0½	0 18 10½	0 19 10½	1 1 3½	1 1 8½	1 3 0	1 3 6	1 3 8	1 3 1½	1 0 9½
1930	1 2 6½	1 1 3	1 0 3	0 19 1½	0 17 7	0 16 10½	0 16 6	0 16 6	0 16 9	0 17 0	0 17 0	0 17 0	0 18 2½
1931	0 17 0	0 16 7½	0 16 0	0 16 0	0 15 11	0 15 5	0 15 1	0 15 0	0 15 0	0 16 9	0 17 0	0 16 6	0 16 0½
1932	0 17 0	0 16 11½	0 16 5½	0 15 9	0 15 7½	0 15 6	0 15 6	0 14 9½	0 14 6½	0 14 6	0 15 4	0 15 6½	0 15 6½
1933	0 16 0½	0 15 11½	0 15 6½	0 15 6	0 15 6	0 15 6	0 15 6	0 15 8½	0 16 1½	0 17 0	0 17 6	0 16 9	0 16 1½
1934	0 19 4½	1 0 6	1 0 1½	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0
1935	1 0 0	0 19 6½	0 19 0½	0 19 0	0 19 0	0 19 0	0 19 0	0 19 0	0 18 9½	0 18 9½	0 19 5½	1 1 2½	0 19 3½
1936	1 2 0	1 2 11½	1 3 2½	1 4 0	1 4 11½	1 5 3½	1 5 1½	1 4 7½	1 4 6	1 4 6	1 4 6	1 4 6	1 4 1½
1937	1 5 6	1 5 10½	1 7 7½	1 12 9½	1 15 0	1 19 3½	1 18 6½	2 0 0	2 0 3½	2 1 10½	2 2 0	2 2 0	1 16 1½
1938	2 0 1½	—	—	—	—	—	—	—	—	—	—	—	—

* Strike period. ‖ Five months.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

Notice

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

ENAMELLING TECHNICIAN desires position with progressive firm. Sound technical and practical experience in wet and dry processes, also foundry.—Box 806, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY FOREMAN desires position. Practical and technical training all branches iron and non-ferrous work, thorough knowledge of cupola, metallurgy, mixing off metals for high-grade engineering castings. Good organiser, can produce castings at economical cost.—Box 798, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROGRESSIVE Foundry Manager, age 40, at present engaged in foundry taking in all types of general engineering castings, mechanised plant, iron and non-ferrous, pattern-shop, etc. Fully capable of taking entire charge, and guarantee results. Go anywhere.—Box 800, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

STEEL FOUNDRY MANAGER (Metallurgist). Experienced Electric Tropenas; excellent recent managerial record, with practical and commercial abilities.—Box 808, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ASSISTANT FOREMAN MOULDER wanted in the West of Scotland for steel foundry (Tropenas plant). Must be energetic and thoroughly familiar with the operation of moulding machines. Write giving full details of experience, age, and wages expected.—Apply Box 812, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN MOULDER for N.E. Coast steel foundry required. Experience green and dry sand essential. Replies giving particulars of experience and salary required to: Box 810, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOREMAN PATTERNMAKER desires re-engagement. Considerable experience as journeyman and foreman on wide class of work, including valve, machine tool, marine and steel castings. (319)

FOUNDRY MANAGER, age 40, requires position. Experience in marine engineering, machine tools and general jobbing foundry. Several years' supervisory experience, capable of taking full charge of important engineering foundry. (320)

YOUNG Foundry Metallurgist desires situation as Foundry Technical Assistant, or similar position. Excellent laboratory, works and technical training, also steelworks experience. (321)

SITUATIONS VACANT AND WANTED—*Contd.*

FOREMAN.—Young energetic man required for small Cast Malleable Foundry in Scotland. Good opportunity for suitable man. Reply with detailed particulars of qualifications and experience, etc., to: Box 804, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

LEADING Hand required ironfoundry, used to heavy and medium castings, jobbing work. Excellent prospects for good man not over 45 years of age. Full particulars and wages required to: Box 790, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & Co., LTD., Station Works, Ecclesfield, Sheffield.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

'Phone **98** Staines.

35/38 H.P. Crossley Horizontal Diesel Oil Engine.

Vertical Crosstube Boiler, 8 ft. 8 in. by 4 ft., 80 lbs. w.p.

2½- and 1½-ton Morris Overhead Hand Cranes, 22-ft. and 20-ft. span.

HARRY H. GARDAM & CO., LTD., STAINES

SANDBLAST PLANTS.

ROOMS size, 12 ft. by 12 ft., 12 ft. by 9 ft., and 6 ft. by 6 ft.

Barrels: 54 in. by 36 in.; 36 in. by 30 in.; 30 in. by 20 in., etc.

Cabinet: 6 ft. by 4 ft.; 4 ft. 6 in. sq. by 3 ft. 6 in. sq., and 30 in. dia.

Table: 9-ft. Guttman.

Air Compressors in stock to suit any of the above plants.

Sand Mills: 7 ft. 6 in., 7 ft., 6 ft., 5 ft. and 4 ft. dia. pans.

Cupolettes: 10 cwts., 15 cwts. and 20 cwts.

Cupolas: 2 and 3 tons.

Morgan Tilting Furnaces: 250 and 400 lbs.

Heavy D.E. Grinding Machine: wheels 24 in. by 4½ in.

Sand Rammers, Disintegrators and Mixers. Air Compressors, Blowers and Exhaust Fans. Moulding Machines, etc., etc.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham
'Phone: Broadwell 1359.

THOS. W. WARD LTD.

MOULDING MACHINES.

No. 7 Ajax Jolt Turnover and Pattern Drawer Moulding Machine; 7" dia. cyls., lifting cap. approx. 8 cwts.

No. 6 Ajax Jolt Ram Pneumatic Rollover Moulding Machine; take 36" x 24" boxes.

No. 0 Pneumatic "Britannia" Jolt Ram Rollover Moulding Machine; take boxes 18" to 20" square.

Write for "Albion" Catalogue.

ALBION WORKS, SHEFFIELD.
'Grams: "Forward." 'Phone: 23001 (10 lines).

MISCELLANEOUS

PATTERNS.—Cleghorn & Co. have new premises at 198-200, Bath Road, Worcester, and are in a better position to cope with all classes of engineers' pattern. 'Phone 264.

MISCELLANEOUS—*Continued*

FOR SALE.—One Kinnear Patent Steel Door for Core Stove, complete with slide bars, etc.; in good condition; to suit opening 12 ft. wide by 9 ft. high. Working drawing available. What offers?—Apply R. W. COLLIN & Co., Pallion Foundry, Sunderland.

PLUMBAGO—Our different grades will serve you well and prices are right. Our STANDARD Nos. 1 and 2 at 18s. and 16s. cwt., carriage paid, have a large sale. TRY IT and save money.—WM. OLSEN, LTD., Hull.

FINEST FOUNDRY BLACKINGS AND FACINGS. Pure Ceylon Plumbago (Import direct), Finest Core Gum, White Dust, Parting Powder (Silica free), Pure Ground Carbon and Electrodes. Quality at reasonable prices. Orders repeated. Send for free sample.

JOHN & C. DURRANS,
PENNINE WORKS,
HAZLEHEAD, NEAR SHEFFIELD.
Telephone: 128 Penistone. Telegrams: "Facings, Penistone."

'Phone: 287 SLOUGH

30" Aluminium Cutting Bandsaw, Price £12

JACKMAN Core Stove ... Price £14

SMEDLEY SAND MILL 4' 3" diam. Price £24

"AJAX" 36" × 24" jolt turnover and pattern-draw moulding machines. (Two in stock) ..... Price £60 each

Foundry Travelling Crane, 2-tons, 30 ft. span ..... Price £35

Good small enclosed Rumbler Price £14

New Small 3' Sandblast Plant.

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH
BUY FROM ME AND SAVE MONEY!

PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun and on occasions—be it admitted—of naughtiness.

Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception.

Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d a year to you. Send Peter and his handicapped pals 3d for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,

SCHOOL FOR THE BLIND
(Founded 1838)
SWISS COTTAGE, LONDON, N.W.3